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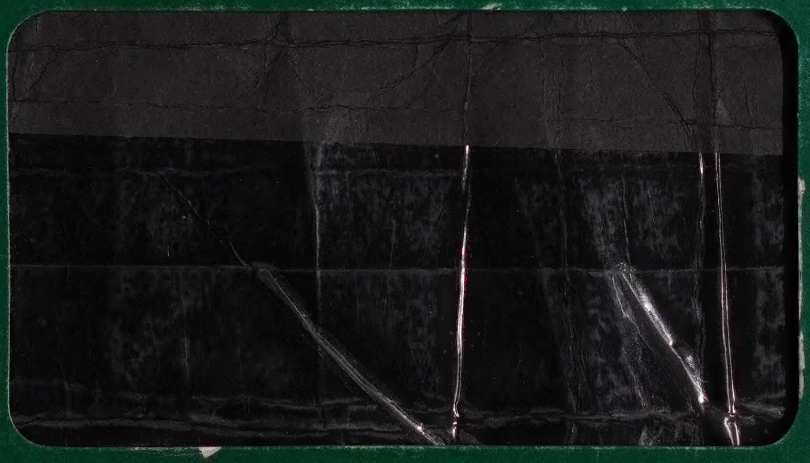

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Instruction Manual

Model 92B

Millivoltmeter

92B
1173

BOONTON ELECTRONICS CORPORATION

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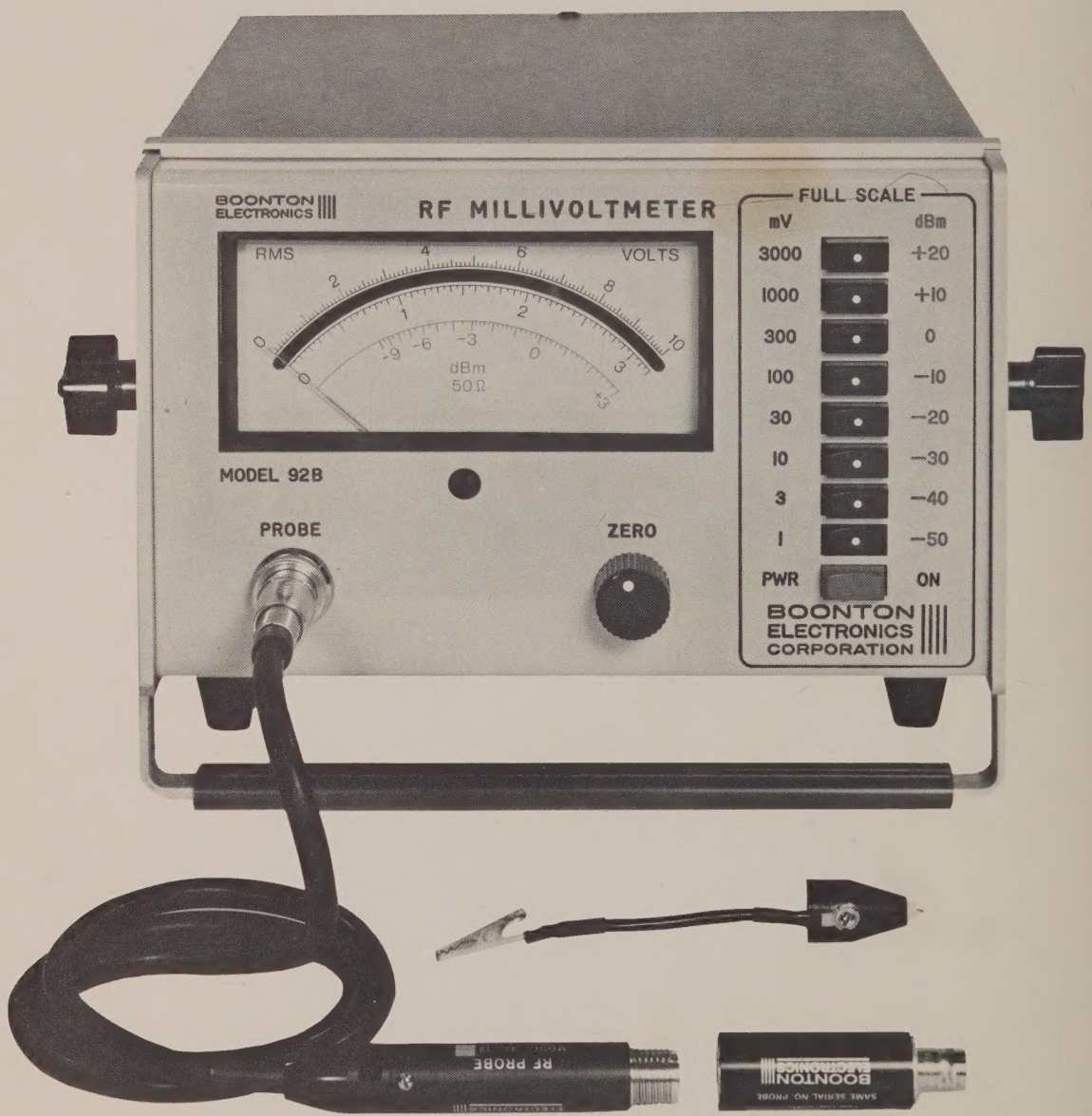


MODEL 92B RF MILLIVOLTMETER

TABLE OF CONTENTS

Chapter		Page
I.	INTRODUCTION	1
	1.1 GENERAL	1
	1.2 EQUIPMENT DESCRIPTION	2
	1.2.1 Frequency Capability	2
	1.2.2 Voltage Capability	2
	1.2.3 True RMS Response	2
	1.2.4 Low Noise	3
	1.2.5 Minimal Zero Adjustment	3
	1.2.6 DC Output	3
II.	SPECIFICATIONS	3
III.	OPERATION	9
	3.1 INSTALLATION	9
	3.1.1 Operating Controls and Indicators	9
	3.2 OPERATING PROCEDURES	10
	3.2.1 Initial Operating Procedure	10
	3.3 OPERATING NOTES	10
	3.3.1 Overload Limits	10
	3.3.2 Connection for Measurements Below 100 MHz	10
	3.3.3 Connection for Measurements Above 100 MHz	10
	3.3.4 Low - Level Measurement	12
	3.3.5 Making the Zero Adjustment	12
	3.3.6 Signal Overload on 1 mV Range	12
	3.3.7 Temperature Effects	12
	3.3.8 Hum, Noise, and Spurious Pick-up	12
	3.4 DC OUTPUT	12
	3.5 LOW FREQUENCY MEASUREMENTS	13
	3.6 CORRECTION CURVES FOR ACTUAL VOLTAGE vs METER READING	13
	3.7 LOSS vs FREQUENCY CORRECTION FOR MODEL 91-8B	13
	3.8 LOSS vs FREQUENCY CORRECTION FOR MODEL 91-14A	13
IV.	THEORY OF OPERATION	16
	4.1 GENERAL	16
	4.1.1 RF Probe	16
	4.1.2 Attenuator and Amplifiers	16
	4.1.3 Synchronous Detector	17

Chapter | Page

4.1.4 Shaping Amplifier 17
4.1.5 Chopper-Driver Circuits 17
4.1.6 Power Supply 17
4.1.7 Programming 17

V. MAINTENANCE

5.1 PERIODIC CALIBRATION 18

5.2 PRECAUTIONS WHEN CHECKING CALIBRATION 18

5.3 CALIBRATION CHECK 18

5.4 CALIBRATION PROCEDURE 18

5.5 TROUBLE - SHOOTING PROCEDURE 20

5.5.1 Cover Removal 20
5.5.2 Chopper Replacement 20
5.5.3 Voltage and Resistance Tests 20
5.5.4 Test Points 20
5.5.5 Replacement of RF Probes 20
5.5.6 Probe Tests 21

VI. INTERFACE 22

6.1 INPUT CHARACTERISTICS 22

6.2 INPUT PULL - UP 22

6.3 ANALOG OUTPUT 22

VII. TABLE OF REPLACEABLE PARTS 24

VIII. SCHEMATIC DRAWINGS Endfold

ILLUSTRATIONS

CHARTS AND DRAWINGS

Figure		Page
1	Input Resistance of RF Probe as a Function of Input Level and Frequency	7
2	Input Capacitance vs Input Level of Model 91-12F Probe (Measured at 10MHz)	8
3	Typical VSWR of Model 91-12F RF Probe with Model 91-8B 50 Ω BNC Adapter	8
4	Typical VSWR of Model 91-12F RF Probe with Model 91-14A Type N Tee Adapter and Model 91-15A 50Ω Termination	8
5	Assembly of Model 91-14A Type N Tee Adapter	11
6	Correction Curves, Actual Voltage vs Meter Reading	14
7A	Model 91-8B 50Ω BNC Adapter Correction Curve	15
7B	Model 91-14A Type N Tee Adapter Correction Curve	15
8	Block Diagram	16
9	Calibration Instructions	19
10	Pin Designations	22
11	External Connections	23
	VSWR Test Block Diagram	21a
	RF Probe Response Block Diagram	21a

TABLES

Table		Page
1	Required Accessories	6
2	Crest Factors	6
3	Model 92B Controls and Indicators	9
4	Connection Recommendations	11

CHAPTER I

INTRODUCTION

1.1 GENERAL

The Model 92 Series RF Millivoltmeter provides an accurate readout of measurements from the low radio frequencies to the gigahertz region, over a voltage range of 200 μV to 3 volts. It is a programmable, solid-state instrument of high sensitivity and accuracy, characterized by high input impedance (see Figs 1 and 2), excellent stability, and low noise.

The Model 92 exhibits true rms response for input signals up to 30 millivolts, gradually approaching peak-to-peak above this level. The meter, however, is calibrated to indicate rms of a sine wave above 30mV.

Input and output connections for external control and readout are provided by a 22-pin card-edge connector at the rear of the instrument.

A linear dc output, whose level is proportional to the rf input voltage, is also provided at a rear connector. This may be used to drive a recorder, remote indicator or other analog devices.

The 92 offers a convenient and accurate means for making a wide variety of measurements. Typical uses of this instrument include:

In transistor testing the instrument may be used to measure β, f_t, and other transistor parameters.

VSWR and return loss measurement using the Model 92 Series with bridge methods, directional couplers, and adjustable or slotted lines.

Gain and loss measurements in wide-band amplifiers, including such design characteristics as stage gain, flatness of the pass band, upper cut-off or corner frequency, negative feedback factors, and other parameters.

Proper adjustment of tuned circuits in narrow-band amplifiers.

The adjustment, measurement of performance, and evaluation of rf filter parameters.

Measurement of vswr or return loss and attenuation of rf attenuators.

Measurement of output levels of signal generators, adjustment of baluns, harmonic distortion of rf signals, and adjustment of circuits for minimum voltage (null) or maximum voltage (peak).

The Model 92 is available in several optional configurations with a basic accuracy of 1% rdg. +1% fs. The standard features of the instrument are:

Remote programmability.

Measures from 200 μV to 3V* from 10 kHz to 1.2 GHz.

True rms response to 30 mV**

Convenient push-button ranging.

DC analog output.

High input resistance, low input capacitance.

Overload protection to 400 Vdc and 10 Vac.

VSWR less than 1.2 up to 1.2 GHz.

*To 300 V, up to 700 MHz, with accessory 100:1 divider.

**To 3V, up to 700 MHz, with accessory 100:1 divider.

The characteristics of the instrument include: high reliability, fast warm-up (1 minute typical), long intervals between calibrations, plug-in PC boards for ease in servicing or modifying, lightweight, and other advantages of solid state design.

1.2 EQUIPMENT DESCRIPTION

The Model 92 is basically a programmable analog instrument with linear dc output. It is available with a full range of options and accessories as described in Chapter II. Logic level programming, TTL/DTL compatible, is standard.

The instrument is sensitive, accurate, sturdily constructed, and protected against overloads. It will perform over extended periods of time without failure or need for recalibration. It is packaged as a compact bench instrument that can be easily mounted in a standard 19-inch rack using an optional rack-mounting kit.

Important input and accuracy specifications are reproduced on a reference plate fastened to the exterior top cover of the instrument. Clips for holding out-of-use accessories are provided at the rear of the instrument. Calibration instructions are reproduced on the underside of the top cover of the instrument.

Standard accessories supplied with the Model 92 Series include one each of the following:

Model 91-12F RF Probe with low-noise cable and connector.

Model 91-8B 50-ohm BNC adapter.

Model 91-13B Probe Tip (removable) with grounding clip lead.

A complete kit of probe accessories is available as optional equipment, including a storage case with space for the Model 91-12F RF Probe and the other standard accessories.

1.2.1 Frequency Capability

The calibrated frequency range of the Model 92 extends from 10 kHz to 1.2 GHz, with uncalibrated response to beyond 8 GHz. Relative accuracy above 1.2 GHz is typically ± 0.5 dB.

A Model 91-8B 50-ohm BNC Adapter is supplied as a standard accessory with the instrument for 50-ohm voltage measurements up to 600 MHz. A correction curve (Figure 7A) is included for frequencies above 50 MHz. For higher-frequency measurements and for through-line voltage measurements the optional accessory, Model 91-14A Tee Adapter, is recommended. It is designed to compensate for the rf probe capacitance and to present a good vswr (better than 1.15) up to 1.2 GHz. It may be used in conjunction with the Model 91-15A 50-ohm load for terminated voltage measurements. In a coaxial line its insertion loss is low; however, a chart (Figure 7B) is supplied showing loss vs. frequency. See Figure 4 for typical vswr.

An optional accessory, the Model 91-4C RF Probe, has a frequency range of 1 kHz to 250 MHz for lower frequency applications.

1.2.2 Voltage Capability

The Model 92 has eight ranges, from 1 millivolt full scale to 3 volts full scale, arranged in 1-3-10 sequence. No attenuator attachments are required for measurements up to 3 volts. While this range is ample for most rf voltage measurements, the capability of the instrument can be increased to 300 volts (up to 700 MHz) by using the optional accessory, Model 91-7C 100:1 Voltage Divider. Use of the 100:1 Voltage Divider also increases the input resistance of the Model 91-4C RF Probe by a factor greater than 100.

1.2.3 True RMS Response

The Model 92 provides true rms response for signal inputs below approximately 30 millivolts (below 3 volts, up to 700 MHz, with the Model 91-7C 100:1 Voltage Divider). As the input level increases, the waveform response gradually approaches peak-to-peak, calibrated on the indicator in rms. Thus, in addition to making precise sinusoidal voltage measurements at all levels, the instrument measures non-sinusoidal or asymmetrical signals within the rms region without loss of accuracy.

1.2.4 Low Noise

The Model 92 has been designed and constructed to hold noise from all sources to a minimum.

The probe cable is of special low-noise design; a vigorous flexing causes only momentary, minor deflections on the most sensitive range. The Model 91-12F Probe is not sensitive to shock or vibration; even sharp tapping on the probe barrel causes no visible deflection on any range.

Amplification takes place at 94 Hz, reducing susceptibility to any 50 or 60 Hz line-frequency-related fields. A unique circuit reduces the low-level noise originating from the mechanical chopper and renders the instrument immune to changes in chopper performance that could occur with the passage of time.

1.2.5 Minimal Zero Adjustment

Zero adjustment is not required on the upper five sensitivity ranges of the Model 92. For measurements on the lower three ranges, the ZERO control is set on the most sensitive range before operation. This control balances out small thermal voltages in the probe elements and, once adjusted, requires only infrequent checking during the course of subsequent measurements.

1.2.6 DC Output

The 92 provides a linear dc output whose current capability of 1 mA into 1000 ohms is extremely stable. When used as part of an automatic test system, the fast response of the instrument's dc output to an input step function allows more tests per unit time.

For system or external requirements, all input and output connections for the 92 are made at the card-edge connector on the rear of the instrument. (See Figure 11 for receptacle connections.)

CHAPTER II

SPECIFICATIONS

Voltage Range:	100 μV to 3V (300V up to 700 MHz with accessory 100:1 voltage divider). Voltage sensitivity is 100 μV.
Full Scale Voltage Range:	1, 3, 10, 30, 100, 300, 1000, and 3000 mV.
dBm Range:	-60 to +23 dBm (+63 dBm up to 700 MHz with optional accessory, Model 91-7C 100:1 Voltage Divider).
Frequency Range:	10 kHz to 1.2 GHz (uncalibrated response to approximately 8 GHz).

Accuracy:

	1% fs plus			
300mV to 3V	1% rdg	1% rdg	3% rdg	10% rdg
100μV to 300mV*	2% rdg			7% rdg
	10 kHz	50 kHz	150 MHz	700 MHz 1.2 GHz

*Below 1 mV, add 1% fs

Meter: 4-1/2 inch taut-band
Two linear voltage scales
0 to 3; 0.05 per division
0 to 10; 0.1 per division
One logarithmic dBm scale
-10 to +3; 0.2 per division max.

Meter Unrest: (1 mV fs range only)

Indicated Voltage	Unrest
Above 600 μV	< 1% fs
300 μV to 600 μV	< 2% fs
100 μV to 300 μV	< 5% fs

Power: 115 or 230 V ±10%, 50 to 400 Hz.

RFI: There is no detectable radiated or conducted leakage from instrument or probe.

Temperature: In accordance with ANSI (ASA) Spec. 39.7.

Temperature Range	Temperature Instrument	Influence RF Probe
Ref. 21° to 25° C	0	0
Normal, 18° C to 30° C	0	±1% rdg
Severe, 10° C to 40° C	±1% rdg	±4% rdg

Waveform Response: True rms response for input levels up to 30 mV (3V to 700 MHz with 100:1 Voltage Divider), with transition to peak-to-peak (calibrated in rms) at higher levels.

Crest Factor: 420 to 1.4 depending upon input level (see Table II).

Input Impedance: See Figures 1 and 2.

VSWR: Less than 1.20 to 1.2 GHz (Return Loss greater than 23 dB). See Figures 3 and 4.

Power Sensitivity: 200 pW, minimum detectable power in 50 ohms.

DC Output: 0 to 10 V dc proportional to rf input voltage. Source resistance of 9 kΩ; will deliver 1 mA into 1 kΩ load. Full scale input step function response time less than 100 ms on 30 mV fs to 3V fs ranges, increasing to 1 sec. on the 1 mV fs range.

Dimensions: 5.2" H (without rubber feet), 8.3" W (1.2 of standard 19 inch rack module) 11.5" D (132 x 211 x 292 mm).

Weight: Net 7 lbs. (3.2 kg)

Accessories Furnished: Model 91-12F, RF Probe. RF Probe with low-noise cable and connector assembly for measurements from 10 kHz to 1.2 GHz; see Figures 1 and 2 for input resistance and capacitance.

Model 91-13B, Probe Tip. Removable Probe Tip with grounding clip lead; for use up to approximately 100 MHz.

Model 91-8B, 50Ω BNC Adapter. Used for measurements up to 600 MHz with a 50-ohm system; for VSWR see curve of Figure 3.

Warm-Up: Warm-up period, typically 1 min. Adjust zero on 1 mV range when measuring below 30 mV.

Accessory Kit (Optional) Model 91-24A: Model 91-6C, Unterminated BNC Adapter. Used for coaxial connection up to approximately 100 MHz, or to 400 MHz when fed from a 50-ohm source in an electrically short system.

Model 91-7C, 100:1 Voltage Divider. Attenuates input signal by a factor of 100 (±1%), permitting measurements up to 300 volts and extending the rms measuring range to 3 volts; increases input resistance by a factor of 1000; operates from 50 kHz to 700 MHz. Maximum input potential, 1000 volts, dc plus peak ac.

Model 91-14A, 50Ω Tee Adapter. Type N Tee Connector; with Model 91-15A termination (see below) permits connecting into 50-ohm line; required for measurements above approximately 100 MHz; for VSWR see curve of Figure 4.

Model 91-15A, 50Ω Termination. Type N 50-ohm termination for use with Model 91-14A Tee Connector.

Model 91-18A, Storage Case. Case for protecting and storing Model 92B accessories.

Other Accessories (Optional) Available:

Model 91-4C: Special 1 kHz to 250 MHz RF Probe. Low Frequency probe for measurements ranging from 1 kHz to 250 MHz; input resistance essentially the same as that of Model 91-12F, RF Probe.

Model 91-16A, Unterminated Type N Adapter. May be used with all probes, except Model 91-23A. Used for coaxial connection up to approximately 100 MHz, or to 400 MHz when fed from a 50-ohm source in an electrically short system.

Model 92-1A, Single Rack Mounting Kit. Kit for mounting one 92B as one-half of a module in a standard 19-inch rack.

Model 92-1B, Double Rack Mounting Kit. Kit for mounting two 92B's side-by-side in a standard 19-inch rack.

Standard Equipment Options:

Model 92B-03. dBV option, dB scale, referred to 1 volt.

Model 92B-04. dBV option, dB scale, referred to 1 volt, is read out on top scale on meter.

Model 92B-05. 75Ω dBm option; dBm scale, referred to 75Ω.

Model 92B-06. 75Ω dBm option; dBm scale, referred to 75Ω, read out on top scale on meter.

Model 92B-07. 50Ω dBm option; dBm scale, referred to 50Ω, read out on top scale on meter.

Model 92B-08. Rear signal-input option.

Model 92B-12. dBmV option, dB scale referred to 1 mV.

IMPORTANT NOTE:

Fully to exploit the capabilities of this instrument, the accessories listed below are required for the indicated ranges of operation.

Table 1. Required Accessories

MEASURING RANGE	REQUIRED ACCESSORY	REMARKS
100 MHz to 600 MHz	Model 91-8B 50Ω Adapter for shielded connection to 50-ohm line; other impedances available on request.	Supplied as standard equipment with the Model 92 Series
Above 600 MHz	Model 91-14A Tee Connector and 91-15A 50Ω Termination for connection into 50-ohm line.	Available separately
1 kHz to 250 kHz	Model 91-4C RF Probe	Available separately
Input levels up to 300 V; rms response with levels to 3V.	Model 91-7C 100:1 Voltage Divider; operates over frequency range from 50 kHz to 700 MHz	Available separately

For details on the availability of these and other Boonton Electronics Accessories for RF Voltmeters, call your local Boonton Electronics Sales Engineering Representative, or write directly to the factory at the address on the title page of this instruction book.

Table 2. Crest Factors

VOLTAGE RANGES (mV) AND CREST FACTORS								
VOLTAGE RANGES (mV)	1	3	10	30	100*	300*	1000*	3000*
CREST FACTOR**	420 to 42	70 to 14	21 to 4.2	7 to 1.4	420 to 42	70 to 14	21 to 4.2	7 to 1.4

*With accessory 100:1 Voltage Divider (see Table 1).
**Maximum permissible ratio of peak to rms value of voltage.

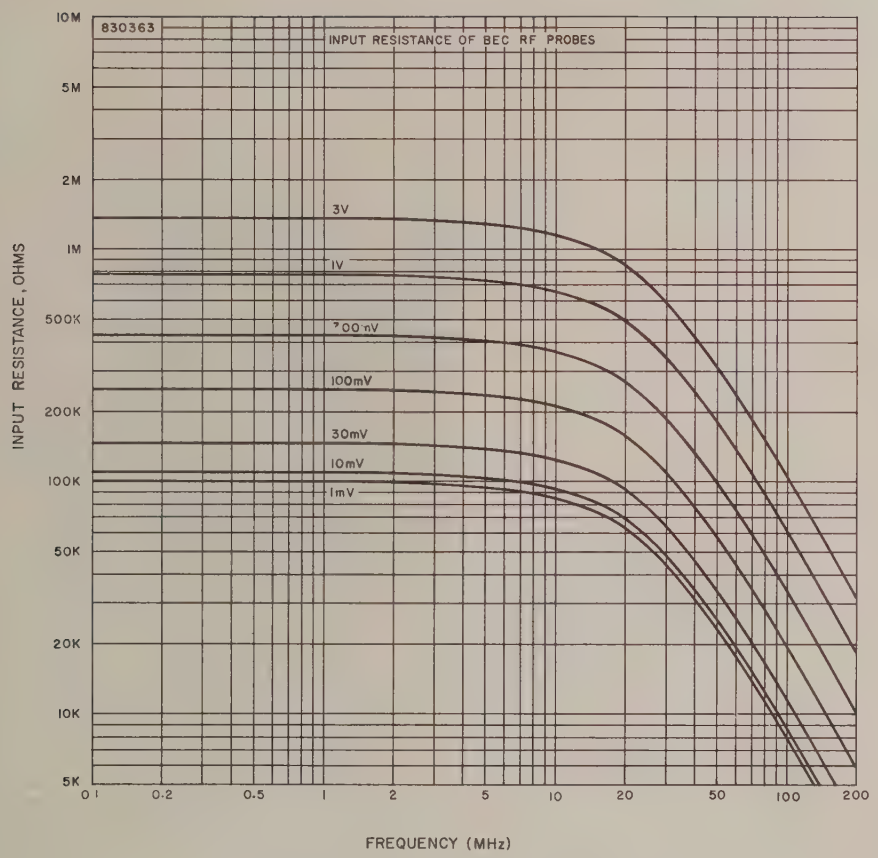


Figure 1. Input Resistance of RF Probe as a Function of Input Level and Frequency

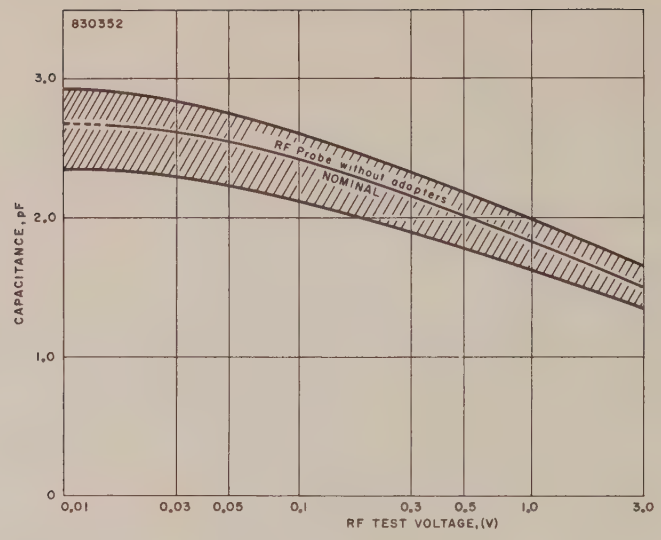


Figure 2. Input Capacitance vs Input Level of Model 91-12F Probe (Measured at 10MHz)

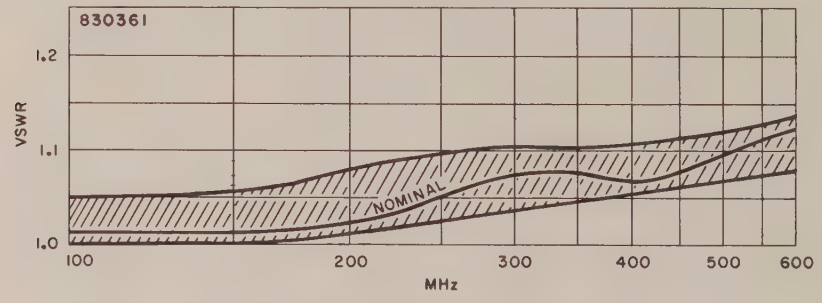


Figure 3. Typical VSWR of Model 91-12F RF Probe with Model 91-8B 50Ω BNC Adapter

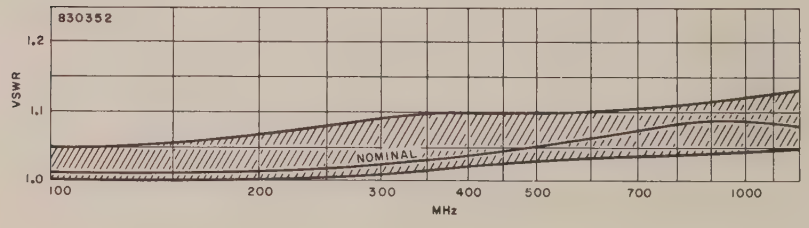


Figure 4.. Typical VSWR of Model 91-12F RF Probe with Model 91-14A Type N Tee Adapter and Model 91-15A 50Ω Termination

CHAPTER III

OPERATION

3.1 INSTALLATION

The Model 92B has been inspected and tested at the factory before packing, and is shipped ready for operation. If there is any indication of shipping damage, immediately notify the carrier before attempting to put the instrument into operation.

3.1.1 Operating Controls and Indicators

The controls and indicators installed on Model 92B are shown in Table 3.

Table 3. Model 92B Controls and Indicators

PWR ON	This switch turns on the instrument power.
FULL SCALE	These range pushbuttons, (1, 3, 10, 30, 100, 300, 1000, and 3000 mV) and (-50, -40, -30, -20, -10, 0, +10, and +20dB) select the operating range.
Meter	A 4-1/2 inch taut-band meter with two linear voltage scales reading out 0 to 3 with 0.05 per division and 0 - 10 with 0.1 per division; and one logarithmic dBm scale reading out -10 to +3 with 0.2 per division maximum.
PROBE (Jack)	The probe cable connects to the instrument through this PROBE jack. Always check that the knurled ferrule nut of the probe cable connection is tightened when in use.
ZERO (Control)	This control is used to zero the instrument.

The following items are on the rear panel:

Fuse Holder and Fuse	A fuse holder is located on the rear panel for installing either a 0.10 ampere, 115V, or a 0.06 ampere, 220 V, Bussman MDL SLO-BLO fuse.
Slide Switch	Switch which is set to 115 V or 230 V, according to the available power source. Be sure that the proper fuse is located in the fuse holder.
Recorder Output Terminals (Rear Panel)	A DC voltage proportional to the indicator reading is available at these terminals. F.S. output = +10V Output resistance = 9 kΩ
Component Holders (Clips)	Three component holders or component clips are located at the rear panel for securing accessories which are not in use.
REMOTE CONNECTIONS (Use with an Amphenol 225-22221-103 connector or equivalent)	A card edge connector is mounted at the rear of the instrument. See Figure 10 for the pin designations.
(Symbol on Rear Panel)	This safety requirement symbol has been adopted by the International Electrotechnical Commission, Document 66 (Central Office) 3, paragraph 5.3 which directs that an instrument be so labeled, if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source.

Verify that the right fuse is installed for the power available and that the switch on the rear panel 0.10A and 0.06A, 50-400Hz, is set to the applicable operating voltage of 115V or 230V. Within a brief time, the use of this symbol will be acted upon by ANSI (ASA).

3.2 OPERATING PROCEDURES

In the following paragraphs, the initial operating procedure for the 92B is described, as well as operating notes and recommended connection methods.

3.2.1 Initial Operating Procedure

a. Be sure that the serial number of the probe to be used is the same as that of the Model 92B. (Each instrument is calibrated for its particular rf probe.) Use of a probe other than that for which the instrument was calibrated may result in measurement errors.

b. Connect the probe cable to the PROBE jack on the front panel.

c. Check the setting of the power switch on the rear panel to be sure that it is set to the proper position for the line voltage available.

d. Plug the instrument's power cable into a power receptacle. Push PWR ON switch button.

e. Press the 1 mV range button; the panel meter pointer should rest on zero. If it does not, use the ZERO control to set the meter to zero. (This adjustment will hold for the other ranges.) The instrument is now ready for use. (See 3.3.5)

3.3 OPERATING NOTES

While using the Model 92B is a direct and straightforward process, there are certain precautions and procedures which MUST be observed to obtain satisfactory results.

3.3.1 Overload Limits

The Model 91-12F RF Probe supplied with the Model 92B is overload-protected to 10 volts, ac, and to 400 volts, dc. EXCEEDING THESE LIMITS MAY RESULT IN PERMANENT DAMAGE TO THE PROBE.

The Model 91-8B 50-ohm Adapter should not be subjected to continuous overload of more than 10 volts (dc + rms ac) to avoid excessive heating of the terminating resistor.

Where voltages above these limits are likely to be encountered, the Model 91-7C 100:1 Voltage Divider is required. Maximum rating of the Voltage Divider is 1000 volts, dc + peak ac.

3.3.2 Connection for Measurements Below 100 MHz

The RF Probe supplied with the Model 92B is equipped with a detachable tip and ground lead. For measurements of signals below approximately 100 MHz, this tip provides a convenient means for both signal and ground connection.

3.3.3 Connection for Measurements Above 100 MHz

For frequencies above 100 MHz, the probe tip should NOT be used with the Model 92B. Connection should be made directly to the center contact of the probe with the ground connection kept as short as possible

The connection recommendations outlined in Table 4 should be followed to maintain specified accuracy.

Table 4. Connection Recommendations

FREQUENCY	SIGNAL CONNECTION
Up to 100 MHz	Probe with tip and grounding lead, or with Model 91-8B (supplied) Probe with Model 91-14A/15A (optional)
100 to 250 MHz	Probe without tip (see Fig. 5), or probe with Model 91-8B (supplied) Probe with Model 91-14A/15A (optional)
250 to 600 MHz	Probe with Model 91-8B (supplied) Probe with Model 91-14A/15A (optional)
600 MHz to 1.2 GHz	Probe with Model 91-14A/15A (See Figure 5) (optional)

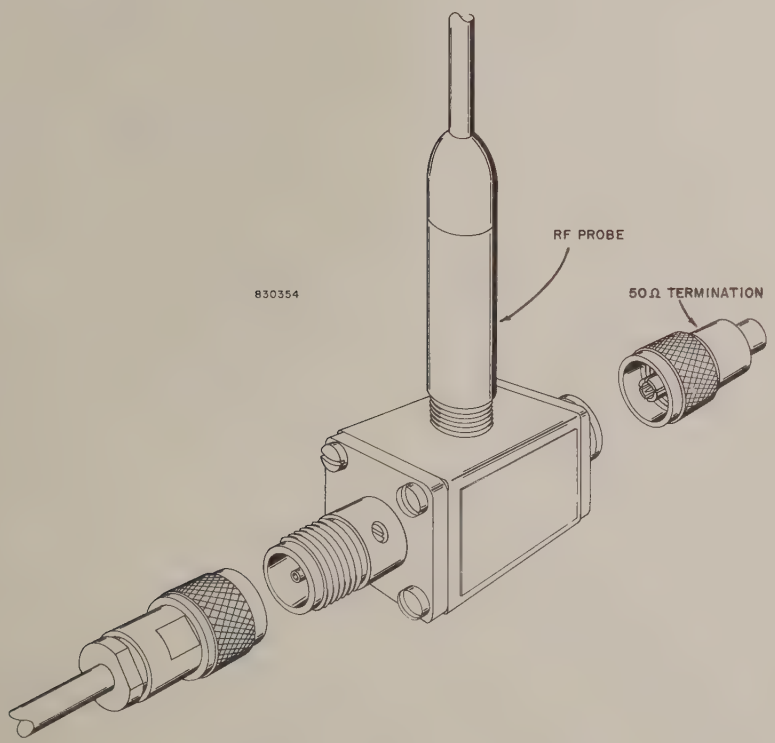


Figure 5. Assembly of Model 91-14A Type N Tee Adapter

3.3.4 Low-Level Measurement

The Model 92B will provide reliable, reproducible measurements of signal levels as low as 100 microvolts.

Preliminary zero adjustment is essential when using the lowest range scale to achieve the specified accuracy, and is strongly recommended for all ranges up to 30 millivolts.

3.3.5 Making the Zero Adjustment

When the instrument is to be used on the 1 mV range, the following zero adjustment procedure should be followed:

a. Set the FULL SCALE range selector to the 1 mV position.

b. Be sure that no voltage is applied to the probe, and that it is adequately shielded from local fields. This can be done by partially unscrewing the probe cap until the tip just breaks contact with the internal connector, leaving the metal shell engaged with the body threads. Alternately, the probe tip can be removed and the 50-ohm termination (Model 91-8B) mounted in its place.

c. Adjust the ZERO control to bring the meter reading to zero. Noise will cause the reading to fluctuate up to ± 5% of full scale. Adjust the ZERO control so that the reading averages zero.

3.3.6 Signal Overload on 1 mV Range

On the most sensitive (1 mV) range, application of a large ac signal overloads the amplifier and a short time is required for the high-impedance input circuit to discharge. This effect is significant for signals above approximately 100 millivolts. Typically, application of a 1 volt signal will require a recovery time of about thirty seconds before subsequent measurements should be made. It should be noted, however, that such overloads cause no damage to the equipment as long as they are within the limits outlined in paragraph 3.3.1.

3.3.7 Temperature Effects

The accuracy specifications for the Model 92B apply over temperatures from 50°F to 104°F. Outside of these limits operation of the equipment is possible but appreciable inaccuracies can be expected. However, no permament change in probe characteristics will result from any reasonable high or low temperature exposure.

It should be noted that inaccuracies of measurement resulting from temperature effects may occur shortly after soldering to the probe tip, or measuring with the probe in the vicinity of heat sources such as resistors, heat sinks, vacuum tubes, and so forth.

When making low-level measurements (below approximately 2 millivolts) it is important to make sure that the probe has attained a uniform temperature throughout its body. A temperature gradient between the inside and outside of the probe can generate a small thermal voltage that may add to the dc output of the detector diodes.

3.3.8 Hum, Noise, and Spurious Pick-up

When measuring low-level signals precautions should always be taken to avoid the possibility of errors of measurement resulting from hum, noise, or stray rf pick-up. Although all low-frequency hum and noise are attenuated at the input, it is still possible for unwanted high-level signals to cause errors. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray pick-up. Typical sources of spurious radiation are: induction or dielectric heating units, diathermy machines, local radio transmitters and grid dip meters.

3.4 DC OUTPUT

The dc output provided at the rear panel binding posts is a linear function (typically within 1%) of the input level, as long as the input signal is greater than 20% of full scale. For inputs less than 20% of full scale the output is NOT linear, but may be corrected by referring to paragraph 3.6 and Figure 6. Polarity of the dc output is positive with respect to the instrument ground, the nega-

tive dc output terminal being at ground potential. Output resistance is 9 kΩ.

3.5 LOW FREQUENCY MEASUREMENTS

The Model 91-12F RF Probe supplied with the Model 92B provides measurements within the specified accuracy from 10 kHz to 1.2 GHz. For measurements at lower frequencies the Model 91-4C RF Probe is available. It operates over a frequency range from 1 kHz to 250 MHz.

Important Note: After installing the Model 91-4C RF Probe, the Model 92B must be checked for accuracy of calibration, and recalibrated if required (see paragraphs 5.3 and 5.4).

3.6 CORRECTION CURVES FOR ACTUAL VOLTAGE vs METER READING

Use the curves of Figure 6 to correct for non-linearity below 20% of full scale on each range.

3.7 LOSS vs FREQUENCY CORRECTION FOR MODEL 91-8B

Use the curve of Figure 7a to make corrections for high-frequency roll-off when using the Model 91-8B 50Ω Adapter.

3.8 LOSS vs FREQUENCY CORRECTION CURVE FOR MODEL 91-14A

Use the curve of Figure 7b to make corrections for transmission loss when using the Model 91-14A Type N Tee Adapter.

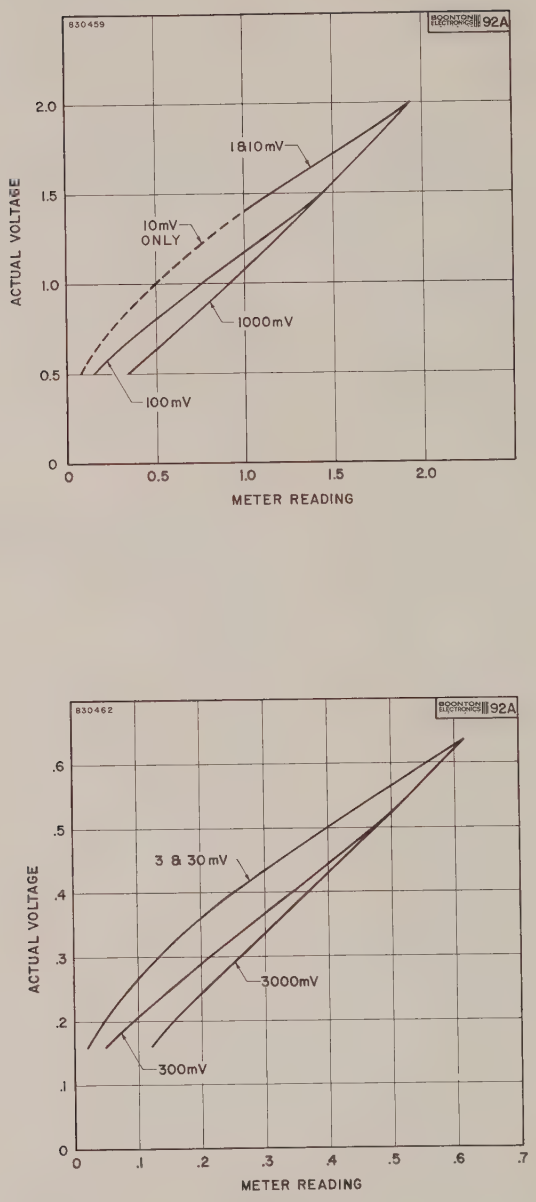
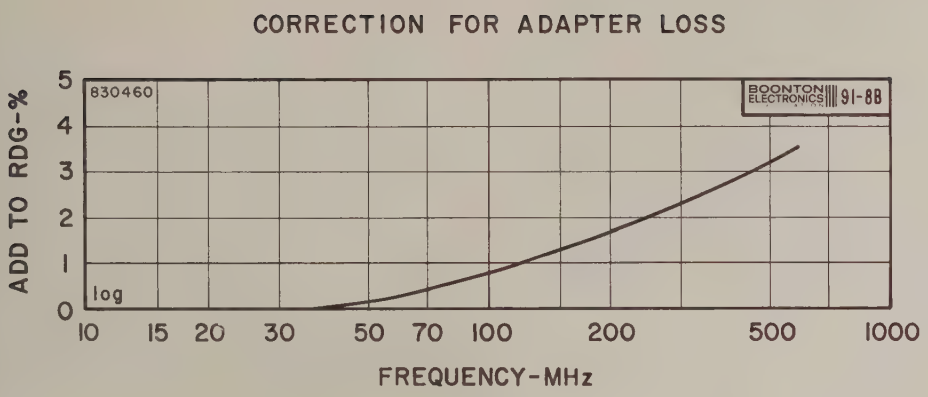


Figure 6. Correction Curves, Actual Voltage vs Meter Reading



EXAMPLE:
AT 250MHz, METER READS 50mV.
ADD 2%. TRUE VOLTAGE IS 51mV.

Figure 7A. Model 91-8B 50Ω BNC Adapter Correction Curve

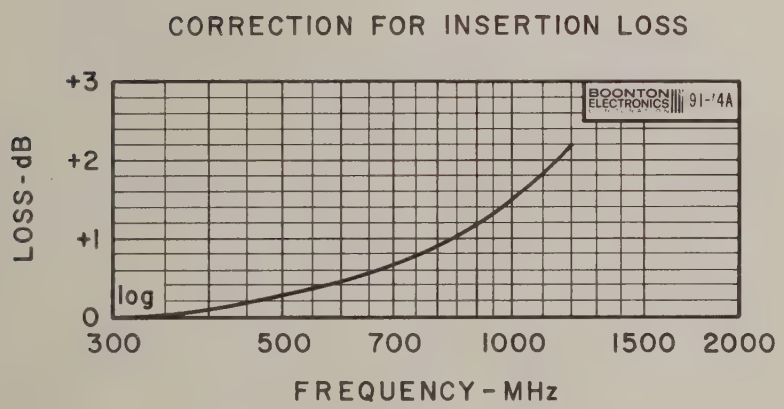


Figure 7B. Model 91-14A Type N Tee Adapter Correction Curve

CHAPTER IV

THEORY OF OPERATION

4.1 GENERAL

The operating principles of the Model 92B are shown in the following block diagram (Figure 8). The essential elements of the instrument are the probe, chopper driver, chopper, attenuator, preamplifier, amplifier, pulse generator, sync detector, shaping amplifier, panel meter and power supply.

4.1.1 RF Probe

The RF Probe embodies a full-wave diode detector which rectifies the signal under study to a dc voltage whose level is a function of the input level. While operating in the square-law region (below approximately 30 millivolts) the detector provides true rms response. As the input level increases beyond 30 millivolts, waveform response gradually approaches peak-to-peak, calibrated on the scale in rms.

In addition to increasing efficiency, use of full-wave rectification in the detector probe permits measurement of signals having highly asymmetrical waveforms without errors stemming from turn-over effect.

The diodes used in the RF Probe have been carefully selected for specific characteristics. The user is urged NOT to attempt their replacement with any off-the-shelf types. In case of damage to probe components, call your local Boonton Electronics Sales Engineering Representative or the factory for instructions.

4.1.2 Attenuator and Amplifiers

The dc output of the probe is converted to ac by the mechanical chopper. The resultant ac signal is applied to the attenuator and amplifier sections. For each range the output voltage from the 2nd amplifier is approximately 3V peak-to-peak. It is accomplished by ranging both the attenuation and the gain of the 2nd amplifier in the following manner:

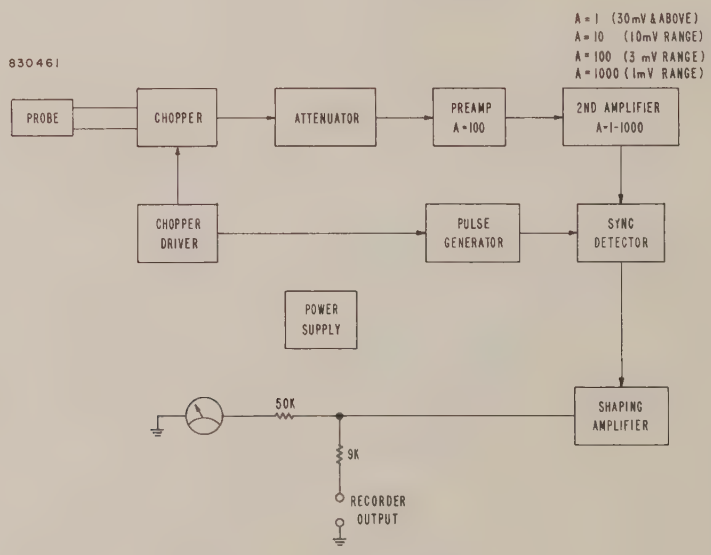


Figure 8. Block Diagram

RANGE	$\frac{1}{ATTN}$	GAIN 2nd AMP
1	1	1000
3	1	100
10	1	10
30	1	1
100	0.15	1
300	0.04	1
1000	0.01	1
3000	0.004	1

The preamplifier has a constant gain of X100, and is designed for very low input noise. Both amplifiers have moderately wide bandwidths and are stabilized by large amounts of negative feedback.

4.1.3 Synchronous Detector

The amplified ac signal from the 2nd amplifier is converted to dc by the synchronous detector. The peak-to-peak amplitude is derived from a shunt-series capacitor storage circuit using JFET switches. The synchronous detector is driven by pulses in the chopper-driver circuit, thus assuring exact synchronization. The characteristics of the detector determine the effective bandwidth of the amplifier-detector combination and allow modification of the bandwidth for different range conditions. The detector also provides conversion without offset, with excellent linearity.

4.1.4 Shaping Amplifier

The conversion of rf to dc in the probe is non-linear, the response being virtually square-law for the lowest ranges and gradually becoming quasi-linear for the 3V range. The shaping amplifier converts the non-linear output of the phase detector to a linear output by using a segmental approximation to the exact correction. The shaping amplifier is actually an operational amplifier so connected that, as the signal increases at its output, its gain is reduced by successively paralleling resistors across the feedback resistors. The number of segments required to adequately linearize the response varies from 6 for the "square-law" ranges down to 2 for the 3V range. The output of the shaping amplifier is +10V which drives the panel meter and is applied to the recorder terminals through a 9 kΩ resistor.

4.1.5 Chopper-Driver Circuits

The chopper-driver block provides all of the drive signals required by the instrument. The chopper frequency is obtained by dividing the output of a unijunction oscillator by two. The oscillator also generates the switching pulse for the synchronous detector. Diode gating feeds the pulse to the proper JFET depending upon chopper phase. The chopper frequency is normally adjusted to 94 Hz, but can be changed as much as ±10 Hz to avoid beating with harmonically related ground signals.

4.1.6 Power Supply

The power supply converts the ac input power to regulated +15V and -15V outputs. Each supply is protected by current limiting against accidental short circuits. Both supplies are adjustable to 15.0 ± 0.1V.

4.1.7 Programming

The instrument is organized around an eight-line ranging system. In each functional subcircuit the switching is accomplished by solid-state devices, generally JFET's, which are actuated by the appropriate range line. The front panel range switch simply connects to the eight range lines to allow range selection. The range lines are buffered by a logic level converter. The instrument may be externally ranged by a logic "0" command on the appropriate range line and manual disable line. (It is recommended that an Amphenol connector, or equivalent, be used for remote programming connection.)

CHAPTER V

MAINTENANCE

NOTE: Values and tolerances shown in this section are not specifications but are provided only as guides to the maintenance and calibration of this instrument.

5.1 PERIODIC CALIBRATION

The Model 92B is designed to provide trouble-free operation over extended periods of time. However, as with any precision instrument, the instrument should be checked periodically to verify proper calibration. To make such calibration checks, the following equipment is required:

a. A reliable signal source of 200 kHz to 500 kHz with less than 1% distortion at levels up to 3 volts across 50 ohms.

b. A precision voltmeter such as the Ballantine Model 310A or 300H, the Boonton Electronics Model 93A or 93AD, or the Hewlett-Packard Model 400D or 400H or equivalent.

c. A precision dc voltmeter capable of measuring ±15.0V with an accuracy of 0.25%.

d. Frequency counter such as Monsanto Model 100A.

5.2 PRECAUTIONS WHEN CHECKING CALIBRATION

When checking the calibration of an instrument having the sensitivity and bandwidth of the Model 92B, it is essential to take precautions against errors resulting from stray pick-up voltages. (See paragraph 3.3.8.) A well-shielded signal source must be used in conjunction with coaxial connections to both the Model 92B and the standard reference meter. Even with a well-shielded generator and connections, it is sometimes possible for the reference meter to pick up stray rf signals and feed them into the probe. It is advisable to test for this condition by disconnecting the standard meter and noting any change in level.

5.3 CALIBRATION CHECK

Using the equipment listed in paragraph 5.1, check the calibration of the Model 92B on each range using a test voltage equal to the full scale value. If the check reveals that recalibration is required, the procedure outlined in paragraph 5.4 should be followed.

5.4 CALIBRATION PROCEDURE

The Model 92B should be calibrated at room temperature (74°F) after a minimum warm-up time of five minutes.

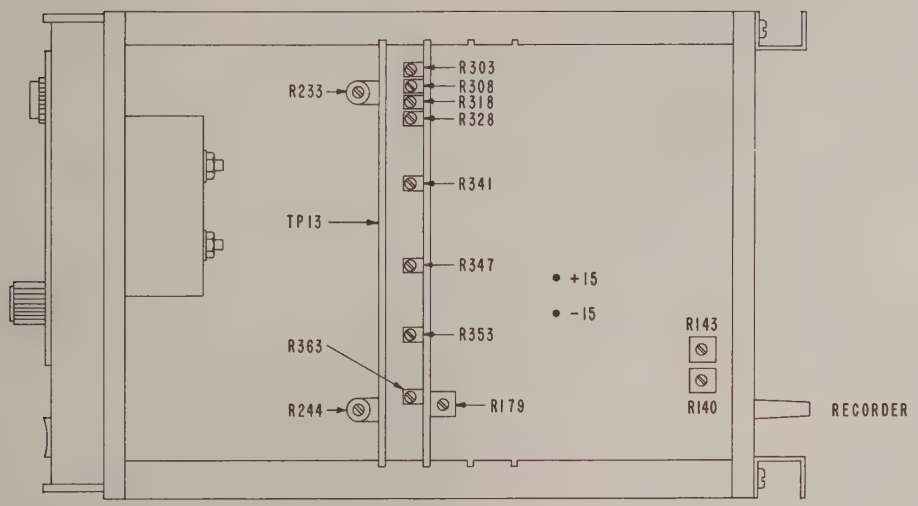
A calibration outline is provided inside the top cover of the instrument (see Figure 9). The adjustment references listed below are the same as those recorded on the top cover.

Adjustment No. 1. Measure the -15.0 V supply voltage at the 15 V Test Point located on the Main Amplifier board at C119. Adjust R143 to -15.0 ± 0.1 V.

Adjustment No. 2. Measure the +15.0 V supply voltage at the +15 V Test Point located on the Main Amplifier board at C118. Adjust R140 for a reading of +15.0 ± 0.1 V.

Adjustment No. 3. Set the FULL SCALE range selector to the 1000 mV range, apply 1000 mV input and measure the chopper frequency at Test Point 13, located on the Chopper-Driver board. Adjust R244 for a frequency of 94 ± 1 Hz (106.4 mS). In some cases it may be desirable to offset the chopper frequency to avoid beating with a harmonic of the power line frequency. Any frequency within the adjustment range will not degrade the performance of the instrument.

Adjustment No. 4. Set the FULL SCALE range selector to the 1 mV range and zero the instrument as described in paragraph 3.3.5



• TEST POINT
† REPEAT STEP #4

ADJ NO	CONT	FUNCTION	RANGE	INPUT ±0.2%	ADJUST
1	R143	-15 V ADJ	—	0	−15.0V ±0.1V AT -15V TP
2	R140	+15 V ADJ	—	0	+15.0V ±0.1V AT +15V TP
3	R244	CHOPPER FREQUENCY	1000 mV	1000 mV	94±1Hz AT TP 13
4	R401	FRONT PANEL ZERO	1 mV	0	AVERAGE ZERO INDICATION
5	R233	DC ZERO	30 mV	0	ZERO INDICATION
6	R353	RANGE ADJ	1000 mV	1000 mV	+10.00V AT RECORDER TERMINALS DC VOLTMETER INPUT >10 M OHMS
7	R179	METER FS ADJ	1000 mV	1000 mV	1000 mV INDICATION
8	R363	RANGE ADJ	3000 mV	3000 mV	3000 mV INDICATION
9 †	R303	RANGE ADJ	1 mV	1 mV	1.000 mV INDICATION
10†	R308	RANGE ADJ	3 mV	3 mV	3.000 mV INDICATION
11†	R318	RANGE ADJ	10 mV	10 mV	10.00 mV INDICATION
12	R328	RANGE ADJ	30 mV	30 mV	30.00 mV INDICATION
13	R341	RANGE ADJ	100 mV	100 mV	100.0 mV INDICATION
14	R347	RANGE ADJ	300 mV	300 mV	300.0 mV INDICATION

Figure 9. Calibration Instructions

Adjustment No. 5. Set the FULL SCALE range selector to the 30 mV range and adjust R233 for a zero reading at the RECORDER terminals on the back panel.

Adjustment No. 6. Set the FULL SCALE range selector to the 1000 mV range and apply 1000 mV input; adjust R353 for +10.00 V at the RECORDER terminals.

Adjustment No. 7. Set the FULL SCALE range selector to the 1000 mV range and apply 1000 mV input; adjust R179 for a 1000 mV indication.

Adjustment No. 8. Set the FULL SCALE range selector to the 3000 mV range and apply 3000 mV input; adjust R363 for a 3000 mV indication.

Adjustment No. 9. Set the FULL SCALE range selector to the 1 mV range (zero the instrument as in Adjustment No. 4), apply 1.000 mV input, and adjust R303 for a reading of 1.000 mV.

Adjustment No. 10. Set the FULL SCALE range selector to the 3 mV range (zero as in Adjustment No. 4), apply 3.000 mV input, and adjust R308 for a reading of 3.000 mV.

Adjustment No. 11. Set the FULL SCALE range selector to the 10 mV range (zero as in Adjustment No. 4), apply 10.00 mV, and adjust R318 for a reading of 10.00 mV.

Adjustment No. 12. Set the FULL SCALE range selector to the 30 mV range, apply 30.00 mV input, and adjust R328 for a reading of 30.00 mV.

Adjustment No. 13. Set the FULL SCALE range selector to the 100 mV range, apply 100.0 mV input, and adjust R341 for a reading of 100.0 mV.

Adjustment No. 14. Set the FULL SCALE range selector to the 300 mV range, apply 300.0 mV input, and adjust R347 for an indication of 300.0 mV.

5.5 TROUBLE-SHOOTING PROCEDURE

The following trouble-shooting procedures describe the instrument's cover removal, chopper replacement and voltage and resistance tests.

5.5.1 Cover Removal

The cover of the instrument may be removed from the case by removing the screw on the top of the case.

5.5.2 Chopper Replacement

If unsatisfactory operation of the Model 92B develops, a replacement chopper should be tried. (NOTE: The chopper used in the Model 92B is a special Boonton Electronics Corporation part. For replacements or spares, call your local Boonton Electronics Representative, or the factory.) If the new chopper does not clear the difficulty, place the original chopper back in the socket. The calibration accuracy should be re-checked after replacement.

5.5.3 Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of the chopper (as noted above) it is advisable to make a systematic check of the ac voltage, dc voltage, and resistance. Once the trouble has been found and corrected, the calibration must be re-checked and readjusted as outlined in paragraphs 5.3 and 5.4.

5.5.4 Test Points

Test points, waveforms, and related test voltages are shown in the Model 92B schematics.

5.5.5 Replacement of RF Probes

The serial number of the Model 92B matches that of the Model 91-12F RF Probe with which it was calibrated at the factory. If it is necessary to change probes for any reason, the instrument's calibration MUST be re-checked. In most cases, full recalibration (see procedure in paragraph 5.4) will be required. Similarly, if the RF Probe supplied with the instrument is exchanged for a Model 91-4C Low Frequency Probe, recalibration will be required. (See paragraph 3.5)

5.5.6 Probe Tests

The probe assemblies furnished with the Model 92B can be checked for VSWR and frequency response by following the procedures detailed in the paragraphs below.

Should a probe exhibit out-of-tolerance performance in these tests, the user is urged not to attempt repair himself but to send it back to the factory for repair or adjustment.

A. VSWR measurement:

1. Test Equipment:

   a. Oscillator for desired frequency range:
      56 - 500 MHz: GR Type 1363
      220 - 920 MHz: GH Type 1362
      450 - 1050 MHz: GR Type 1361A

   b. Oscillator Power Supply: GR Type 1263-C

   c. GR Voltmeter Rectifier Type 874-VR

   d. Slotted Line: GR Type 900 LB

   e. RF VTVM: BEC Model 91H, 91DA, 92B, or GR Detector Type 1241

   f. Tee Adapter: BEC Model 91-14A

   g. 50-ohm Termination: BEC Model 91-15A

2. Test Procedure:

   a. Assemble the equipment as shown in the block diagram following this section.

   b. Set the oscillator to the desired test frequency and adjust the output level for a reading of approximately half-scale on the 30 mV voltmeter range.

   c. Adjust the carriage of the slotted line to a point of minimum voltage on the meter, and record the value.

   d. Adjust the carriage to a maximum-voltage point and record this value.

   e. The VSWR is equal to the ratio of the two voltages recorded in steps c and d.

   f. The measurement may be repeated at other frequencies as required.

B. Frequency Response

1. Test Equipment:

   a. Oscillator for desired frequency range:
      56 - 500 MHz: GR Type 1363
      220 - 920 MHz: GR Type 1362
      450 - 1050 MHz: GR Type 1361A

   b. Power supply: GR Type 1263-C

   c. GR Voltmeter Rectifier Type 874-VR

   d. 1.0 GHz Low-Pass Filter: GR Type 874-F100L

   e. 20 dB 50-Ω Pad: GR Type 874-G20

   f. BEC Model 91-14A Tee Adapter

   g. BEC Model 91-15A 50-ohm termination

   h. BEC Model 92B R F Millivoltmeter

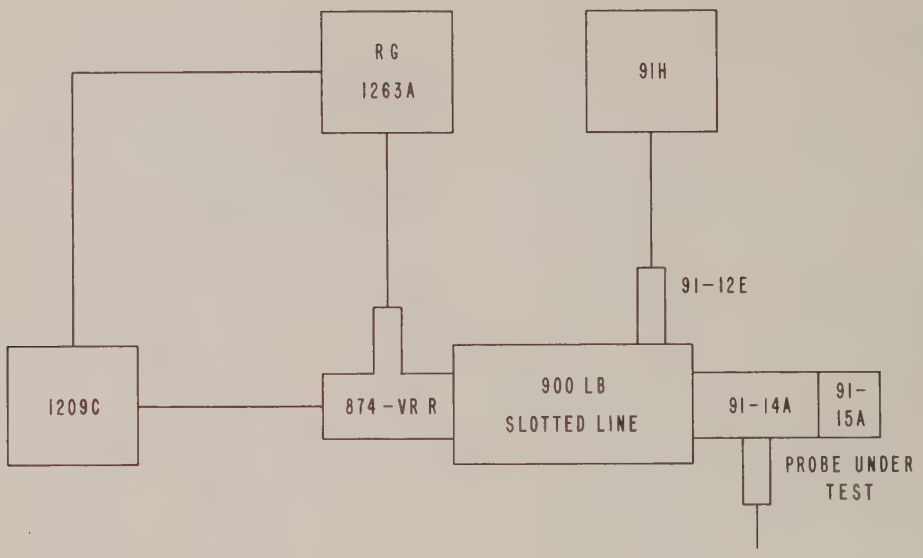
2. Test Procedure:

   a. Assemble the equipment as shown in the block diagram following this section.

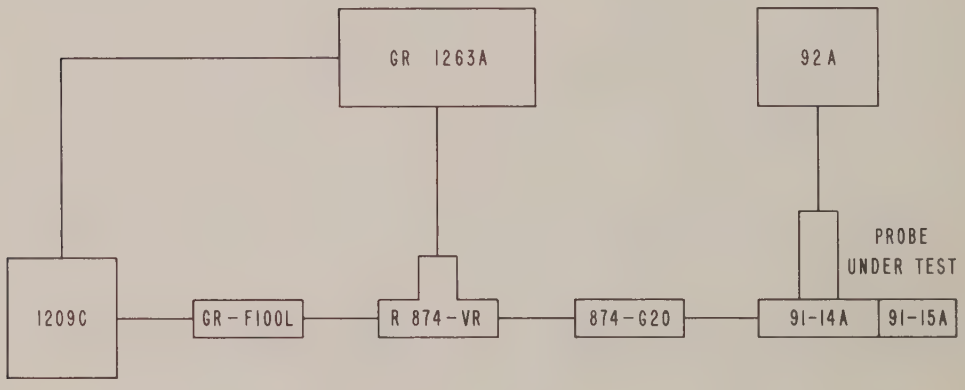
   b. Set the oscillator to the low-frequency end of its tuning range and the voltmeter to the 100 mV range. Adjust the oscillator power to give a reading of 0 dBm on the meter.

   c. Adjust the oscillator to successively higher frequencies as convenient, recording the voltmeter reading at each frequency. The results may be plotted on a graph, if desired.

BLOCK DIAGRAM OF RF PROBE VSWR TEST



BLOCK DIAGRAM OF RF PROBE RESPONSE TEST



CHAPTER VI

INTERFACE

PROGRAMMING INPUTS AND DATA OUTPUT

Pin No.	Function	Comment	Command	Unit Loading
7	Man. disable	Disables front panel range selection	0	0.1
16	1mV range	Selects range provided manual dis-	0	0.1
15	3mV "	able has also been selected; select-	0	0.1
14	10mV "	ing more than one range will result	0	0.1
13	30mV "	in incorrect indications. Range lines	0	0.1
12	100mV "	must be deselected for manual oper-	0	0.1
11	300mV "	ation.	0	0.1
10	1 V "		0	0.1
9	3 V "		0	0.1
5	Common	Power line ground at rear panel	N/A	N/A
4	DC Analog	+10V for full scale of "1" ranges +9.5V for "3" ranges	N/A	N/A

Figure 10. Pin Designations

6.1

Input Characteristics

TTL Series	Logic Level	Voltage Level	Current per Unit Load
Standard Power 54/74	0	± 0.7 V	-1.6 mA*
	1	2.4 to 5.25V	40μA

*The - current indicates current out of the input (external command device must sink this current). A standard power (Series 54/74) TTL output will sink and source 10 unit loads.

6.2

Input Pull-Up

All input terminals have internal pull-up. The current sourced by this pull - up when the input is brought to a logic level 0 is included in the loading shown in the "Unit Loading" column of the chart.

6.3

Analog Output

Source resistance is = 9 KΩ

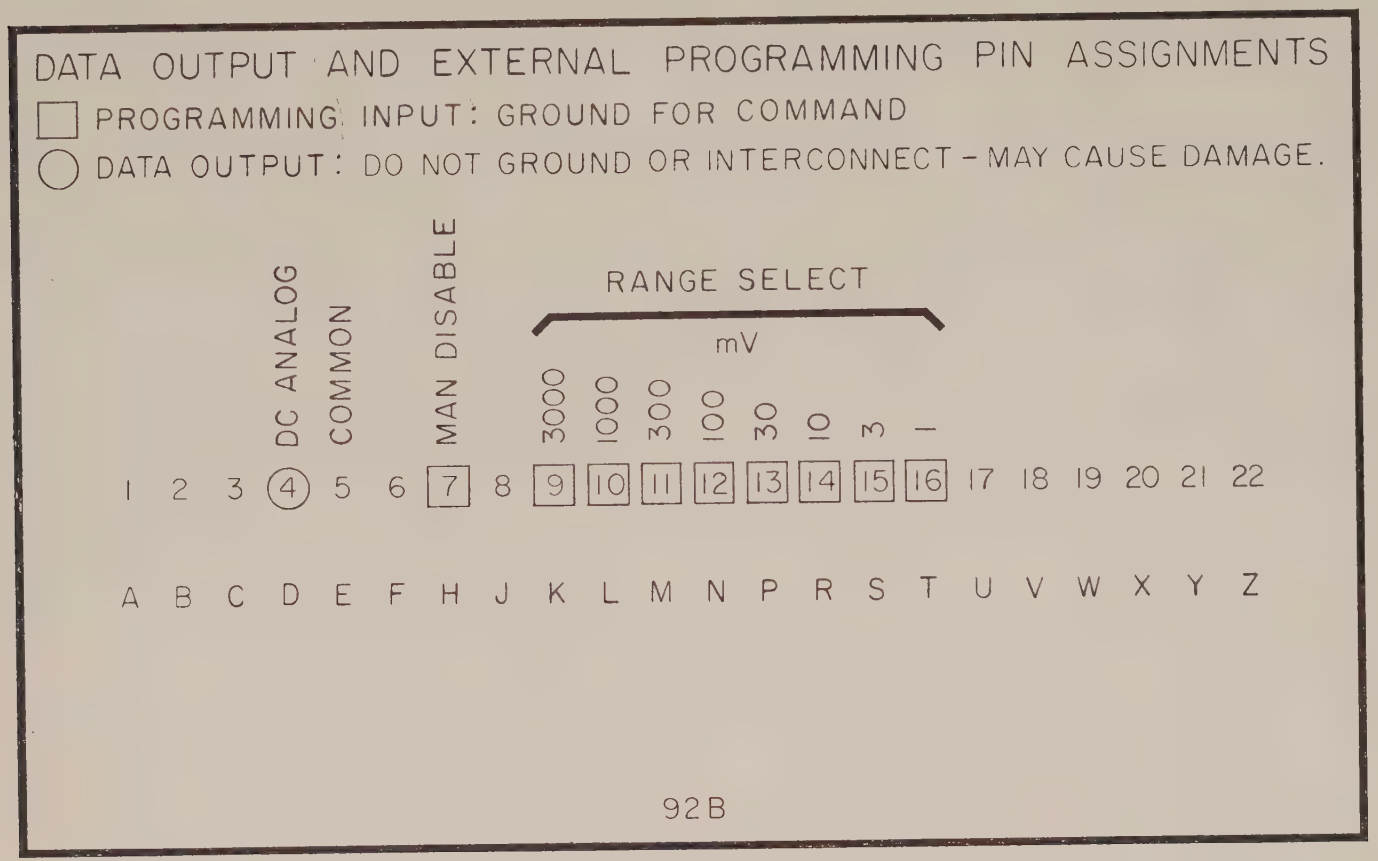

DATA OUTPUT AND EXTERNAL PROGRAMMING PIN ASSIGNMENTS
PROGRAMMING INPUT: GROUND FOR COMMAND
DATA OUTPUT: DO NOT GROUND OR INTERCONNECT - MAY CAUSE DAMAGE.
DC ANALOG COMMON
MAN DISABLE
RANGE SELECT
mV
3000
1000
300
100
30
10
3
—
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
A B C D E F H J K L M N P R S T U V W X Y Z
92B

Figure 11. External Connections

TABLE OF REPLACEABLE PARTS

Reference	Description			BEC Part No.
A201	Operational Amplifier		Nat. Semi. LM302H	535003
A301	"		Nat. Semi. LM301AN	535012
C101	Capacitor	100nF 10% 200V	Sprague 192P10402	234005
C102	"	10µF 20% 20V	Kemet K10E20	283205
C103	"	100pF 5% 500V	Arco DM15F101-J	200001
C104	"	10µF 20% 20V	Kemet K10E20	283205
C105	"	33µF 20% 15V	Kemet K33E15	283206
C106	"	10µF 20% 20V	Kemet K10E20	283205
C107	"	1.0µF 20% 100V	Electron Prod. W1-105	236007
C108	"	1.0µF 20% 35V	Kemet K1E35	283199
C109	"	50µF 25V	Sprague TE1209	283159
C110	"	" "	" "	"
C111	"	100nF 10% 200V	Sprague 192P10402	234005
C112	"	250µF 40V	Mallory Type PFP	283207
C113	"	" "	" "	"
C115	"	100nF 25V +80%-20%		224124
C116	"	" " " "		"
C118	"	100µF 25V	" "	283105
C119	"	" "	" "	"
C201	Capacitor	100nF 10% 50V	TRW 463UWU	234046
C202	"	6.8nF 10% 200V	Sprague 192P68292	234044
C203	"	100pF 5% 500V	Arco DM15F101-J	200001
C204	"	" " "	" "	"
C205	"	22nF 10% 200V	Sprague 192P22392	230101
C206	"	100nF 10% 50V	TRW 463UWU	234046
C207	"	100pF 5% 500V	Arco DM15F101-J	200001
C208	"	100nF 10% 50V	TRW 463UWU	234046
C209	"	10nF DISC. 100V	Erie 805-Y5V01032	224119
C210	"	" " "	" "	"
C211	"	18nF 5% 200V	Sprague 192P18352	234064
C212	"	220nF 10% 50V	TRW 463UWU	234075
C213	"	100pF 5% 500V	Arco DM15F101-J	200001
C214	"	50µF 25V	Sprague TE1209	283159
C215	"	" "	" "	"
C216	"	" "	" "	"
C217	"	150µF-10%+75% 15V		283307
C301	Capacitor	10nF 100V	Erie 805-Y5V01032	224119
C302	"	33pF 5% 500V	Arco DM-15-330J	200049
C303	"	10nF 100V	Erie 805-Y5V01032	224119
C401	Capacitor	100nF 10% 50V	TRW 463UWU	234046
C402	"	" " "	" "	"

Reference		Description		BEC Part No.
CR101	Diode	L Pwr., P1V125 450mA	Fairchild FD300	530052
CR102	"	L Pwr., Silicon	Texas Inst. 1N914	530058
CR103	"	" "	" "	"
CR104	Diode, Zener	11V 5% 500mW	Motorola 1N5243B	530101
CR105	" "	6.8V 5% 500mW	Motorola 1N5235B	530089
CR106	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR107	"	" "	"	"
CR108	"	" "	"	"
CR109	"	" "	"	"
CR110	"	" "	"	"
CR111	Bridge	1.5A 200V	GI KBP02	532013
CR112	"	" "	"	"
CR115	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR117	"	" "	"	"
CR118	"	" "	"	"
CR119	"	" "	"	"
CR120	"	" "	"	"
CR121	"	" "	"	"
CR122	"	" "	"	"
CR123	"	" "	"	"
CR124	"	" "	"	"
CR201	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR202	"	" "	"	"
CR203	"	" "	"	"
CR204	"	" "	"	"
CR205	"	" "	"	"
CR206	"	" "	"	"
CR207	"	" "	"	"
CR208	"	" "	"	"
CR209	"	" "	"	"
CR210	"	" "	"	"
CR211	"	" "	"	"
CR212	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR213	"	" "	"	"
CR214	"	" "	"	"
CR215	"	" "	"	"
CR216	"	" "	"	"
CR217	"	" "	"	"
CR218	"	" "	"	"
CR219	"	" "	"	"

Reference		Description		BEC Part No.
CR301	Diode	L Pwr., Silicon	T.I. 1N914	530058
CR302	"	" "	"	"
CR303	"	" "	"	"
CR304	"	" "	"	"
CR305	"	" "	"	"
CR306	"	" "	"	"
CR307	"	" "	"	"
CR308	"	" "	"	"
DS401	Lamp		Tungsol 349	545107
DS402	"		"	"
G401	Chopper	Special	Airpax, Type 3 6	540113
IC101	Regulator		μA7805	535011
IC102	"		"	"
IC104	"		MFC 6050	535007
IC105	"		"	"
J101	Connector	Card Edge, 22 Pos.	Amphenol 143-022-03	479231
J102	"	" " "	" "	"
J401	Receptacle		Amphenol 80-PC-2 FT	479119
M401	Meter and Scale			554216
Q101	FET	Junction, Silicon	Motorola 2N5459	528019
Q102	"	" "	" "	"
Q104	"	" "	" "	"
Q105	"	Silicon, N-Channel	T.I. T1S58	528038
Q106	"	MOS-FET, P-Channel	Hughes HDGP-1000	528066
Q107	FET	MOS-FET, P-Channel	Hughes HDGP-1000	528066
Q108	"	Junction, Silicon	Motorola 2N5459	528019
Q109	Transistor	Selected, Special		528044
Q110	"	NPN, Silicon	Motorola 2N5088	528047
Q111	"	PNP, Silicon	" 2N5087	528042
Q112	"	" "	" MPS-A66	528048
Q113	"	" "	" 2N5087	528042
Q114	"	NPN, Silicon	" 2N5088	528047
Q115	FET	N-Channel, Silicon	T.I. T1S58	528038
Q116	"	" "	"	"
Q117	"	" "	"	"
Q118	"	Junction, Silicon	Motorola 2N5459	528019
Q119	"	" "	" "	"
Q120	"	" "	" "	"

Reference		Description		BEC Part No.
Q121	Transistor	PNP, Darlington	" MPS-A66	528048
Q122	"	" "	" MPS-6516	528037
Q124	"	PNP, Silicon	" "	"
Q125	"	" "	" "	"
Q126	"	" "	" "	"
Q127	"	" "	" "	"
Q128	"	" "	" "	"
Q129	"	" "	" "	"
Q130	"	" "	" "	"
Q131	"	" "	" "	"
Q201	Transistor	Unijunction, Silicon	Motorola 2N4871	528051
Q202	"	NPN, Silicon	" MPS-A20	528043
Q203	"	PNP, Silicon	" 2N5087	528042
Q204	"	NPN, Silicon	" 2N5088	528047
Q205	"	NPN, Silicon	" MPS-A20	528043
Q206	FET	Silicon	" MPS-A12	528052
Q207	Transistor	NPN, Silicon	" MPS-A20	528043
Q208	"	N-Channel, Junction	T.I. T1S58	528093
Q209	"	NPN, Silicon	Motorola MPS-A20	528043
Q210	"	N-Channel, Junction	T.I. T1S58	528093
Q211	FET	Junction, Silicon	Motorola 2N5459	528019
Q212	Transistor	NPN, Silicon	" MPS-A20	528043
Q213	"	NPN, Silicon	" 2N5308	528050
Q214	"	" "	" "	"
Q301	FET	Junction, Silicon	Motorola 2N5459	528019
Q302	"	" "	" "	"
Q303	"	S " "	" "	"
Q304	Transistor	PNP, Silicon	" 2N5087	528042
Q305	FET	Junction, Silicon	" 2N5459	528019
Q306	Transistor	PNP, Silicon	" 2N5087	528042
Q307	FET	Junction, Silicon	" 2N5459	528019
Q308	Transistor	PNP, Silicon	" 2N5087	528042
Q309	FET	Junction, Silicon	" 2N5459	528019
Q310	Transistor	PNP, Silicon	" 2N5087	528042
Q311	FET	Junction, Silicon	" 2N5459	528019
Q312	Transistor	PNP, Silicon	" 2N5087	528042
Q313	FET	Junction, Silicon	" 2N5459	528019
Q314	"	" "	" "	"
Q315	"	" "	" "	"
Q316	"	" "	" "	"
Q317	Transistor	PNP, Silicon	" 2N5087	528042
Q318	"	NPN, Silicon	" 2N5088	528047
Q319	"	PNP, Silicon	" 2N5087	528042
Q320	"	NPN, Silicon	" 2N5088	528047
Q321	"	PNP, Silicon	" 2N5087	528042
Q322	"	" "	" "	"

Reference		Description			BEC Part No.
Q323	FET	Junction, Silicon	"	2N5459	528019
Q324	"	" "	"	"	"
Q325	Transistor	PNP, Silicon	"	2N5087	528042
Q326	FET	Junction, Silicon	"	2N5459	528019
Q327	Transistor	PNP, Silicon	"	2N5087	528042
Q328	FET	Junction, Silicon	"	2N5459	528019
Q329	Transistor	PNP, Silicon	"	2N5087	528042
Q330	FET	Junction, Silicon	"	2N5459	528019
Q331	"	" "	"	"	"
Q332	Transistor	PNP, Silicon	"	2N5087	528042
Q333	"	" "	"	"	"
Q334	"	" "	"	"	"
Q335	FET	Junction, Silicon	"	2N5459	528019
Q336	"	" "	"	"	"
Q337	Transistor	PNP, Silicon	"	2N5087	528042
Q338	"	" "	"	"	"
Q339	"	" "	"	"	"

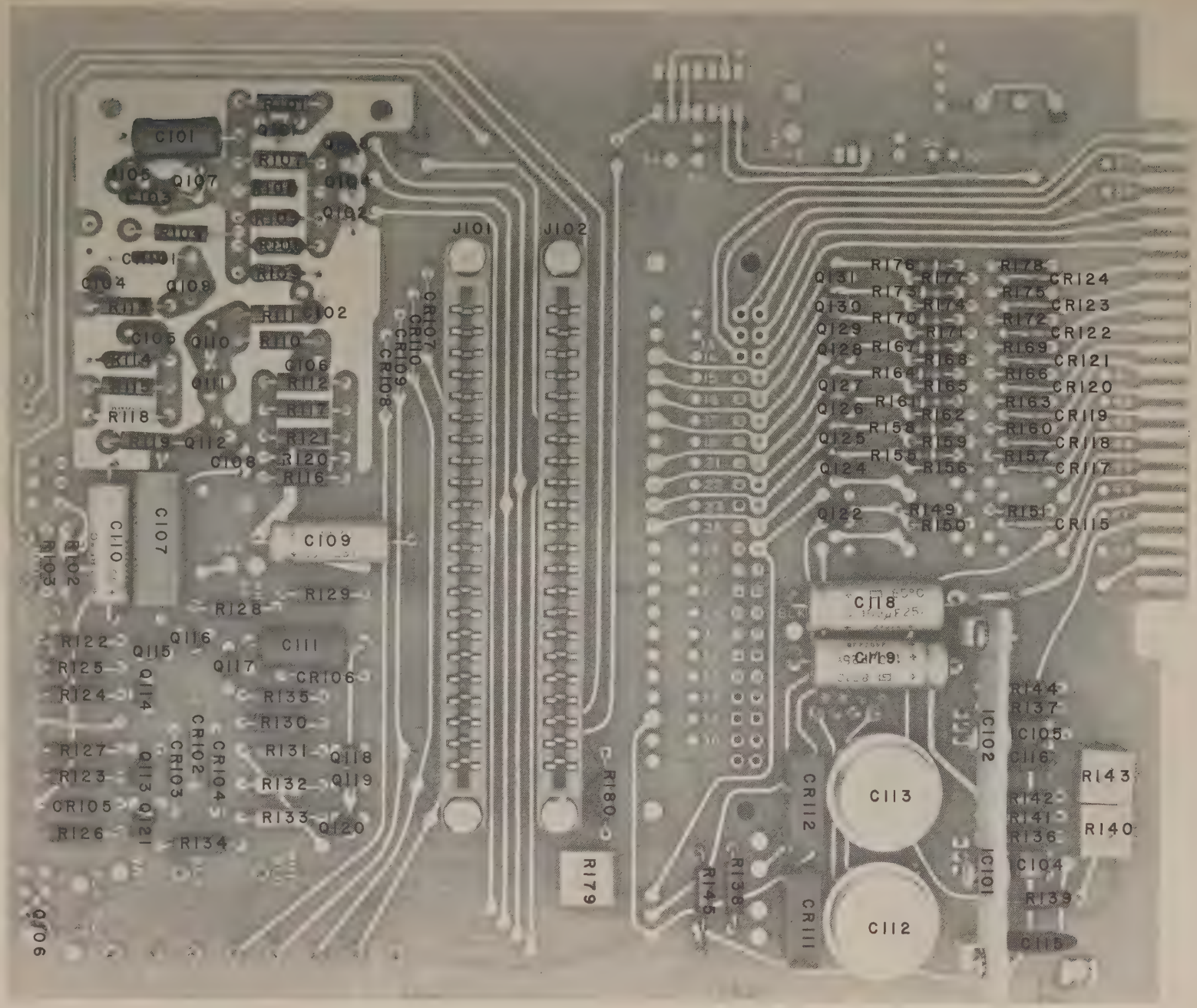
R101	Resistor	1M 1/2W 5%	AB EB	301159
R102	"	6.2KΩ 1/4W 5%	AB CB	300101
R103	"	" " "	"	"
R104	"	5.6M 1/4W 1%	Pyrofilm PME65	325397
R105	"	24.3K 3/8W 1%	T.I. MC60D	340405
R106	"	80.6K 3/8W 1%	" "	326467
R107	"	374K 3/8W 1%	" "	340547
R108	"	294K 3/8W 1%	" "	340535
R109	"	1.0M 3/8W 1%	" "	326700
R110	"	91K 1/2W 5%	AB EB	301134
R111	"	47K 1/2W 5%	"	301127
R112	"	33K 1/2W 5%	"	301123
R113	"	300K 1/2W 5%	"	301146
R114	"	169Ω 3/8W 1%	T.I. MC60D	340147
R115	"	10K 1/2W 5%	AB EB	301111
R116	"	" " "	"	"
R117	"	33K 1/2W 5%	"	301123
R118	"	15K 3/8W 1%	T.I. MC60D	340378
R119	"	15K 1/2W 5%	AB EB	301115
R120	"	3.6K 1/2W 5%	"	301100
R121	"	3K 1/2W 5%	"	301098
R122	"	1M 1/2W 5%	"	301159
R123	"	2.7K 1/2W 5%	"	301097
R124	"	5.6K 1/2W 5%	"	301105
R125	"	" " "	"	"
R126	"	1KΩ 1/2W 5%	"	301087
R127	"	5.1K 1/2W 5%	"	301104
R128	"	15K 1/2W 5%	"	301115

Reference		Description		BEC Part No.
R129	"	1K 1/2W 5%	"	301087
R130	"	10K 1/2W 5%	"	301111
R131	"	30.1K 3/8W 1%	T.I. MC60D	326397
R132	"	3.01K 3/8W 1%	" "	340297
R133	"	301Ω 3/8W 1%	" "	340176
R134	"	33.2Ω 3/8W 1%	" "	340063
R135	"	1M 1/2W 5%	AB EB	301159
R136	"	1K 1/2W 5%	"	301087
R137	"	1K 1/2W 5%	"	301087
R138	"	15K 1/2W 5%	"	301115
R139	Resistor	1.62K 3/8W 1%	T.I. MC60D	340267
R140	Variable	200Ω 1/2W 10%	72PR200 Beckman	311304
R141	Resistor	604Ω 3/8W 1%	T.I. MC60D	340213
R142	"	1.62K 3/8W 1%	" "	340267
R143	Variable	200Ω 1/2W 10%	72PR200 Beckman	311304
R144	Resistor	604Ω 3/8W 1%	T.I. MC60D	340213
R145	"	9.09K 3/8W 1%	" "	340354
R149	"	160K 1/4W 5%	AB CB	300135
R150	"	39K 1/4W 5%	"	300120
R151	"	100K 1/4W 5%	"	300130
R155	"	160K 1/4W 5%	"	300135
R156	"	39K 1/4W 5%	"	300120
R157	"	100K 1/4W 5%	"	300130
R158	"	160K 1/4W 5%	"	300135
R159	"	39K 1/4W 5%	"	300120
R160	"	100K 1/4W 5%	"	300130
R161	"	160K 1/4W 5%	"	300135
R162	"	39K 1/4W 5%	"	300120
R163	"	100K 1/4W 5%	"	300130
R164	"	160K 1/4W 5%	"	300135
R165	"	39K 1/4W 5%	"	300120
R166	"	100K 1/4W 5%	"	300130
R167	"	160K 1/4W 5%	"	300135
R168	"	39K 1/4W 5%	"	300120
R169	"	100K 1/4W 5%	"	300130
R170	"	160K 1/4W 5%	"	300135
R171	"	39K 1/4W 5%	"	300120
R172	"	100K 1/4W 5%	"	300130
R173	"	160K 1/4W 5%	"	300135
R174	"	39K 1/4W 5%	"	300120
R175	"	100K 1/4W 5%	"	300130
R176	"	160K 1/4W 5%	"	300135
R177	"	39K 1/4W 5%	"	300120
R178	"	100K 1/4W 5%	"	300130
R179	Variable	10K 1/2W 10%	72PR10K Beckman	311328
R180	Resistor	46.4K 3/8W 1%	T.I. MC60D	340438

Reference		Description		BEC Part No.
R201	Resistor	10K 1/2W 5%	AB EB	301111
R202	"	22K 1/2W 5%	"	301119
R203	"	10K 1/2W 5%	"	301111
R204	Resistor	100Ω 1/2W 5%	AB EB	301063
R205	"	33K 1/2W 5%	"	301123
R206	"	10K 1/2W 5%	"	301111
R207	"	100K 1/2W 5%	"	301135
R208	"	3.3K 1/2W 5%	"	301099
R209	"	4.7K 1/2W 5%	"	301103
R210	"	10K 1/2W 5%	"	301111
R211	"	150K 1/2W 5%	"	301139
R212	"	10K 1/2W 5%	"	301111
R213	"	" " "	"	"
R214	"	22K 1/2W 5%	"	301119
R215	"	10K 1/2W 5%	"	301111
R216	"	270K 1/2W 5%	"	301145
R217	"	240K 1/2W 5%	"	301144
R218	"	10K 1/2W 5%	"	301111
R219	"	15K 1/2W 5%	"	301115
R220	"	10K 1/2W 5%	"	301111
R221	"	" " "	"	"
R222	"	12K 1/2W 5%	"	301113
R223	"	4.7K 1/2W 5%	"	301103
R224	"	12K 1/2W 5%	"	301113
R225	"	100K 1/2W 5%	"	301135
R226	"	" " "	"	"
R227	"	15K 1/2W 5%	"	301115
R228	"	10K 1/2W 5%	"	301111
R229	"	100K 1/2W 5%	"	301135
R230	"	12K 1/2W 5%	"	301113
R231	"	4.7K 1/2W 5%	"	301103
R232	"	100K 1/2W 5%	"	301135
R233	Variable	2K 1/2W 20%	Bourns 3359W-1-202	311285
R234	Resistor	100K 1/2W 5%	AB EB	301135
R235	"	" " "	"	"
R237	"	100K 1/2W 5%	"	301135
R238	"	" " "	"	"
R239	"	1.6K 1/2W 5%	"	301092
R240	"	300Ω 1/2W 5%	"	301074
R241	"	62Ω 1W 5%	AB GB	302072
R242	"	150K 1/2W 5%	AB EB	301139

Reference		Description		BEC Part No.
R243	Resistor	510K 1/2W 5%	AB EB	301152
R244	Variable	50K 1/2W 20%	Bourns 3359W-1-203	311282
R245	Resistor	47Ω 1/2W 5%	AB EB	301055
R301	Resistor	130Ω 1/2W 5%	AB EB	301066
R302	"	4.7MΩ 1/2W 5%	"	301175
R303	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R304	Resistor	10K 3/8W 1%	T.I. MC60D	326376
R305	"	4.7MΩ 1/2W 5%	AB EB	301175
R306	"	51.1K 3/8W 1%	T.I. MC60D	340443
R307	"	2.49K 3/8W 1%	" "	340287
R308	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R309	Resistor	28.7K 3/8W 1%	T.I. MC60D	340414
R310	"	200K 3/8W 1%	" "	340515
R311	"	100K 3/8W 1%	" "	340478
R312	"	40.2K 3/8W 1%	" "	326401
R313	"	191K 3/8W 1%	" "	340512
R314	"	11K 3/8W 1%	" "	340364
R315	"	4.7MΩ 1/2W 5%	AB EB	301175
R316	"	29.4K 3/8W 1%	T.I. MC60D	340415
R317	"	95.3K 3/8W 1%	" "	340476
R318	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R319	Resistor	28.0K 3/8W 1%	T.I. MC60D	340412
R320	"	64.9K 3/8W 1%	" "	340456
R321	"	1.00M 3/8W 1%	" "	326700
R322	"	26.1K 3/8W 1%	" "	340408
R323	"	46.4K 3/8W 1%	" "	340438
R324	"	10K 3/8W 1%	" "	326376
R325	"	4.7MΩ 1/2W 5%	AB EB	301175
R326	"	45.3K 3/8W 1%	T.I. MC60D	326403
R327	"	2.49K 3/8W 1%	" "	340287
R328	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R329	Resistor	270K 1/2W 5%	AB EB	301145
R330	"	21.5K 3/8W 1%	T.I. MC60D	340398
R331	"	240K 3/8W 1%	" "	340524
R332	"	18K 1/2W 5%	AB EB	301117
R333	"	26.1K 3/8W 1%	T.I. MC60D	340408
R334	"	154K 3/8W 1%	" "	340501
R335	"	47K 1/2W 5%	AB EB	301127
R336	"	54.9K 3/8W 1%	T.I. MC60D	340447

Reference		Description		BEC Part No.
R337	Resistor	191K 3/8W 1%	T.I. MC60D	340512
R338	"	4.7MΩ 1/2W 5%	AB EB	301175
R339	"	82.5K 3/8W 1%	T.I. MC60D	340468
R340	"	178K 3/8W 1%	" "	326514
R341	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R342	Resistor	17.8K 3/8W 1%	T.I. MC60D	340388
R343	"	2.74K 3/8W 1%	" "	340292
R344	"	4.7 MΩ 1/2W 5%	AB EB	301175
R345	"	24.3K 3/8W 1%	T.I. MC60D	340405
R346	"	232K 3/8W 1%	" "	340522
R347	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R348	Resistor	95.3K 3/8W 1%	T.I. MC60D	340476
R349	"	453K 3/8W 1%	" "	340557
R350	"	4.7MΩ 1/2W 5%	AB EB	301175
R351	"	200K 3/8W 1%	T.I. MC60D	340515
R352	"	634K 3/8W 1%	" "	340575
R353	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R354	Resistor	14.3K 3/8W 1%	T.I. MC60D	340377
R355	"	2.49K 3/8W 1%	" "	340287
R356	"	34.8K 3/8W 1%	" "	340423
R357	"	523K 3/8W 1%	" "	340565
R358	"	4.7MΩ 1/2W 5%	AB EB	301175
R359	"	162K 3/8W 1%	T.I. MC60D	340503
R360	"	806K 3/8W 1%	" "	340587
R361	"	10K 3/8W 1%	" "	326376
R362	"	2.74K 3/8W 1%	" "	340292
R363	Variable	1K 1W 10%	Bourns 3007P-1-102	311256
R364	Resistor	127K 3/8W 1%	T.I. MC60D	340491
R365	"	604K 3/8W 1%	" "	340572
R401	Variable	5K 2W 20%	CTS 550	311255
RT301	Thermistor	100Ω 10%	Fenwal CB21J1	325005
S401	Switch	Push Button	Centra-Lab PB10	465146
S402	"	Slide	Craft 46562 F	465134
T401	Transformer	Power		446068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Q103
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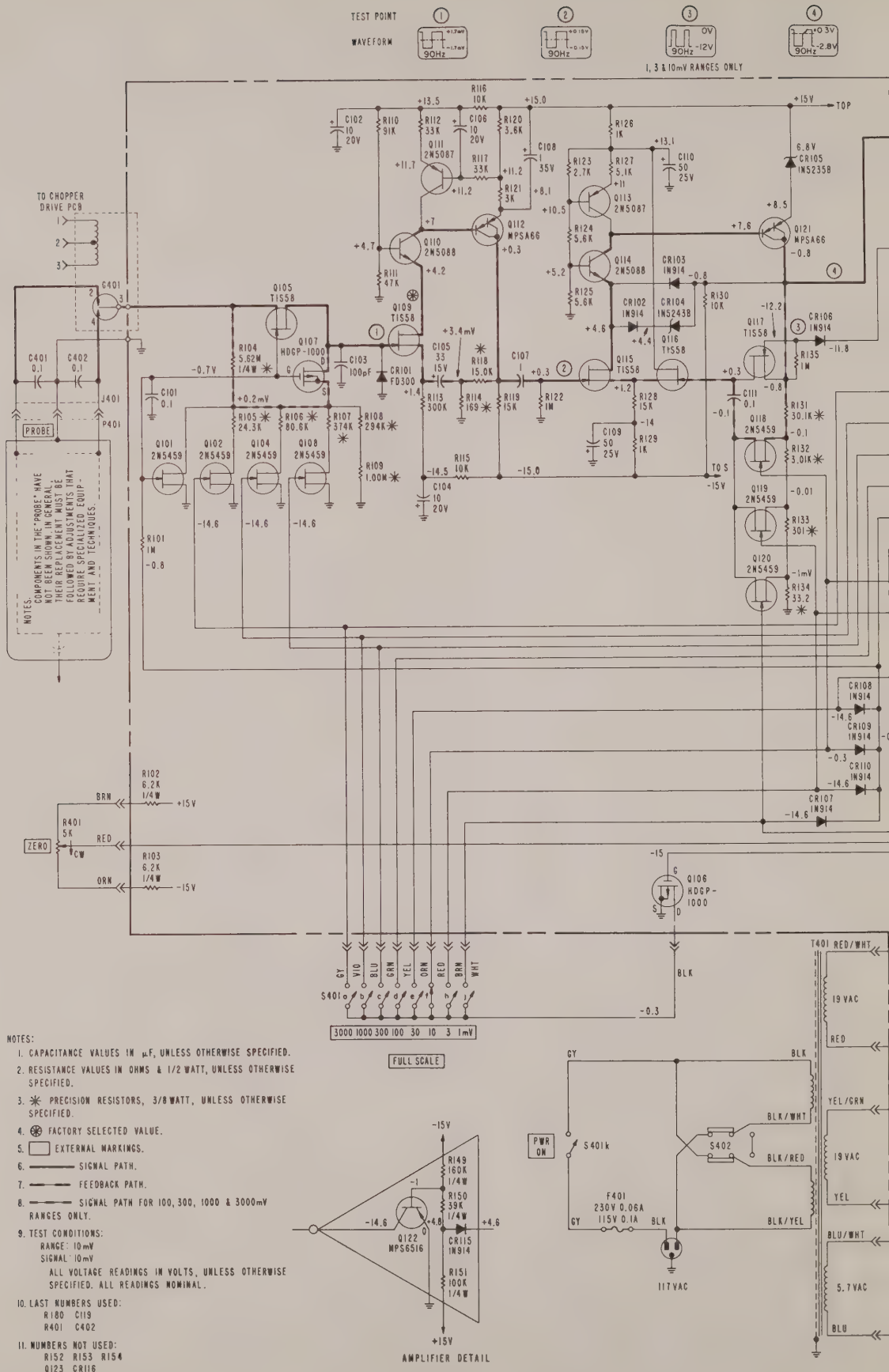
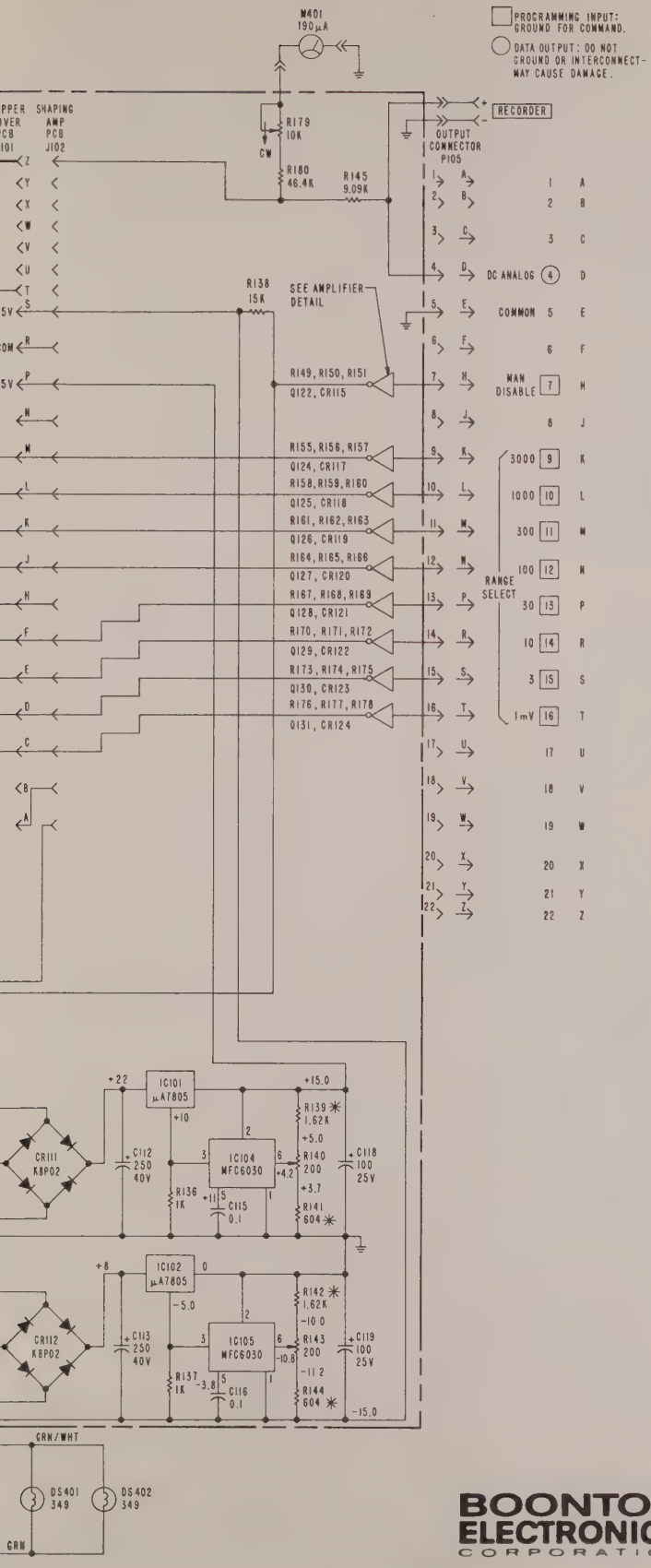


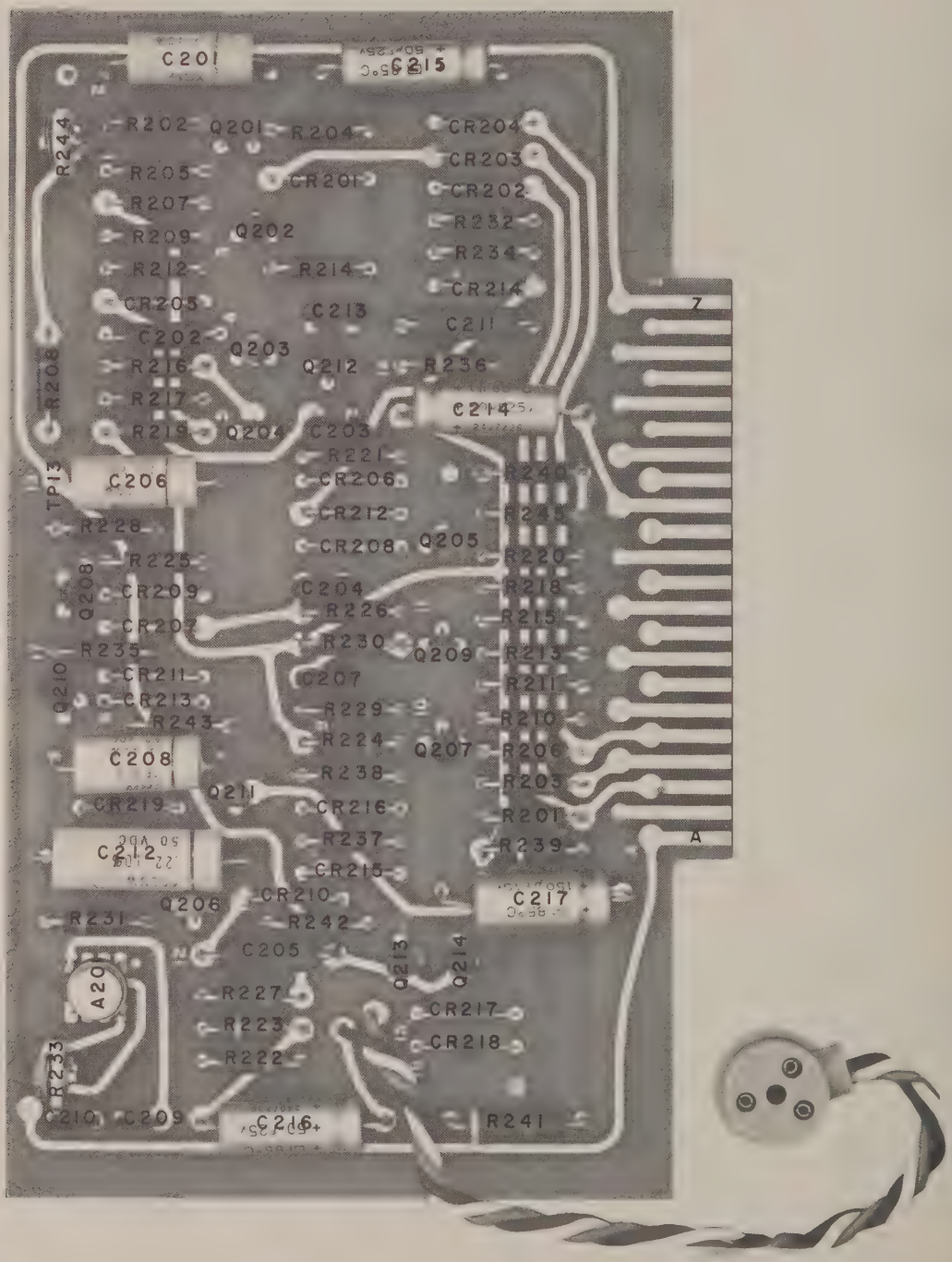
NOTES:

1. CAPACITANCE VALUES IN μF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS & 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
3. ✳ PRECISION RESISTORS, 3/8 WATT, UNLESS OTHERWISE SPECIFIED.
4. ⊛ FACTORY SELECTED VALUE.
5. □ EXTERNAL MARKINGS.
6. ——— SIGNAL PATH.
7. ——— FEEDBACK PATH.
8. ——— SIGNAL PATH FOR 100, 300, 1000 & 3000mV RANGES ONLY.
9. TEST CONDITIONS:
   RANGE: 10mV
   SIGNAL: 10mV
   ALL VOLTAGE READINGS IN VOLTS, UNLESS OTHERWISE SPECIFIED. ALL READINGS NOMINAL.
10. LAST NUMBERS USED:
    R180 C119
    R401 C402
11. NUMBERS NOT USED:
    R152 R153 R154
    Q123 CR116



BOONTON ELECTRONICS CORPORATION

MODEL 92B
Amplifier Schematic
E830605A


C201
C215
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R202
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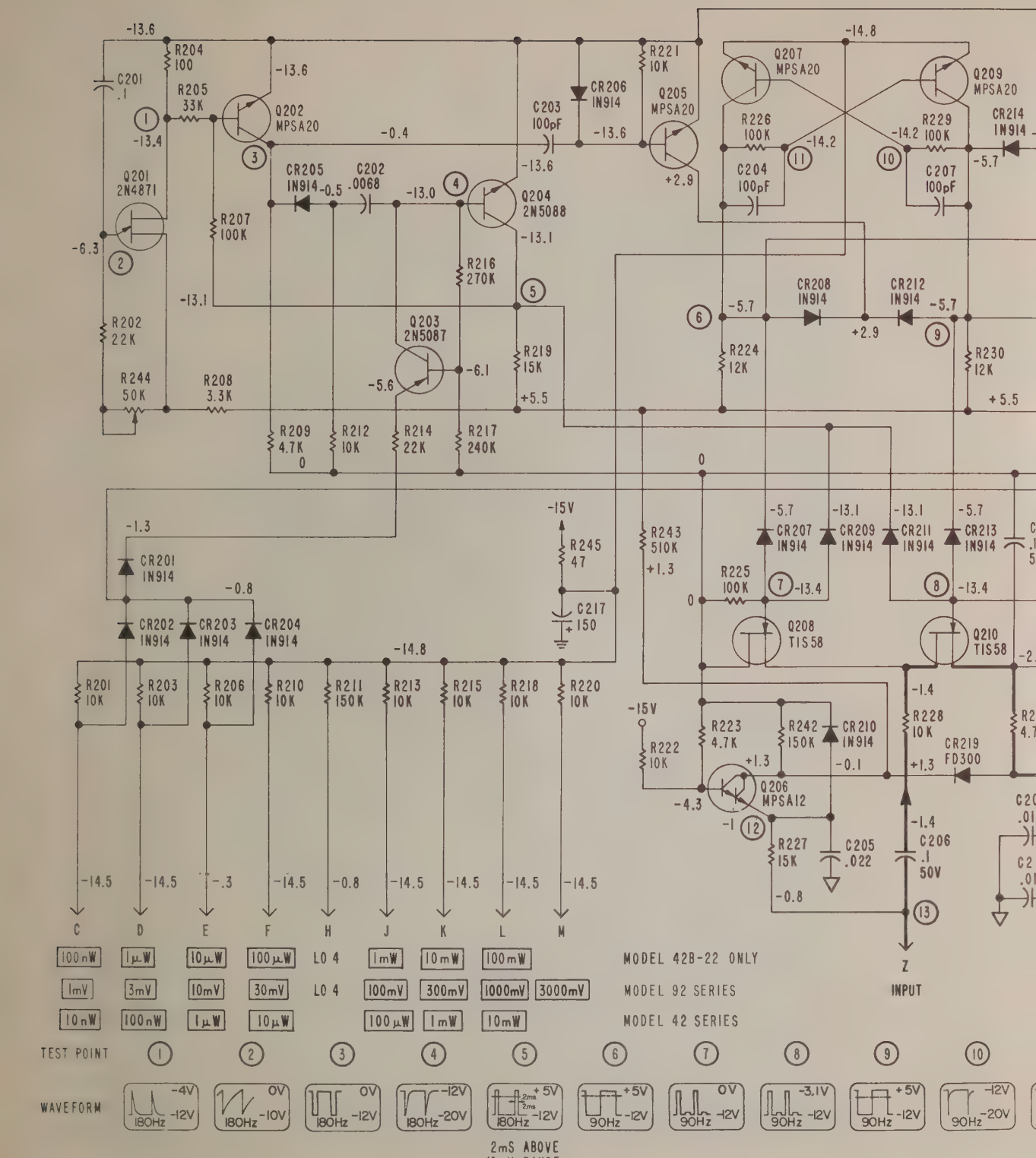
R241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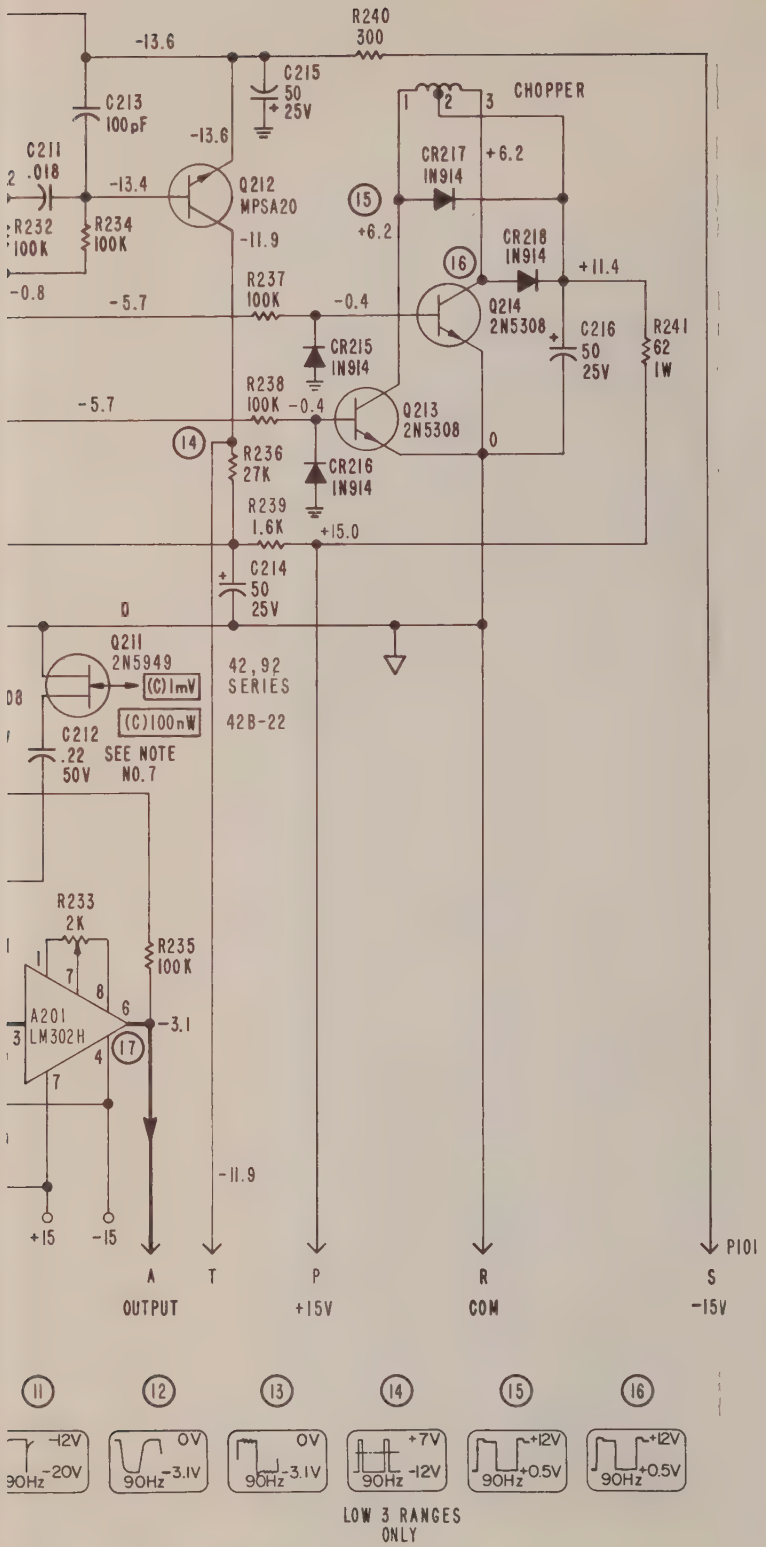
R205 33K
Q202 MPSA20
R221 10K
CR206 IN914
C203 100pF
Q205 MPSA20
Q207 MPSA20
Q209 MPSA20
R226 100K
R229 100K
CR214 IN914
C204 100pF
C207 100pF
Q201 2N4871
R207 100K
CR205 IN914
C202 .0068
Q204 2N5088
R216 270K
R202 22K
R244 50K
R208 3.3K
Q203 2N5087
R219 15K
CR208 IN914
CR212 IN914
R224 12K
R230 12K
R209 4.7K
R212 10K
R214 22K
R217 240K
CR201 IN914
CR202 IN914
CR203 IN914
CR204 IN914
R245 47
C217 150
R243 510K
CR207 IN914
CR209 IN914
CR211 IN914
CR213 IN914
R225 100K
Q208 TIS58
Q210 TIS58
R201 10K
R203 10K
R206 10K
R210 10K
R211 150K
R213 10K
R215 10K
R218 10K
R220 10K
R222 10K
R223 4.7K
R242 150K
CR210 IN914
R228 10K
CR219 FD300
Q206 MPSA12
R227 15K
C205 .022
C206 .1 50V
Z INPUT
C D E F H J K L M
100nW 1μW 10μW 100μW LO 4 1mW 10mW 100mW
1mV 3mV 10mV 30mV LO 4 100mV 300mV 1000mV 3000mV
10nW 100nW 1μW 10μW 100μW 1mW 10mW
MODEL 42B-22 ONLY
MODEL 92 SERIES
MODEL 42 SERIES
TEST POINT 1 2 3 4 5 6 7 8 9 10
WAVEFORM
2mS ABOVE
10mV RANGE
10μW RANGE (42B-22 ONLY)
4. COMMON
5. SIGNAL PATH
NOTES:
1. CAPACITANCE VALUES IN μF, UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE VALUES IN OHMS & 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
3. EXTERNAL MARKINGS.
6. TEST CONDITIONS:
10mV RANGE 10mV SIGNAL } 42, 92 SERIES
10μW RANGE 10μW SIGNAL } 42B-22 ONLY
ALL VOLTAGES NOMINAL. ALL READINGS IN VOLTS, UNLESS OTHERWISE SPECIFIED.



P101
CONNECTS TO J101
ON AMP. BD. 565675

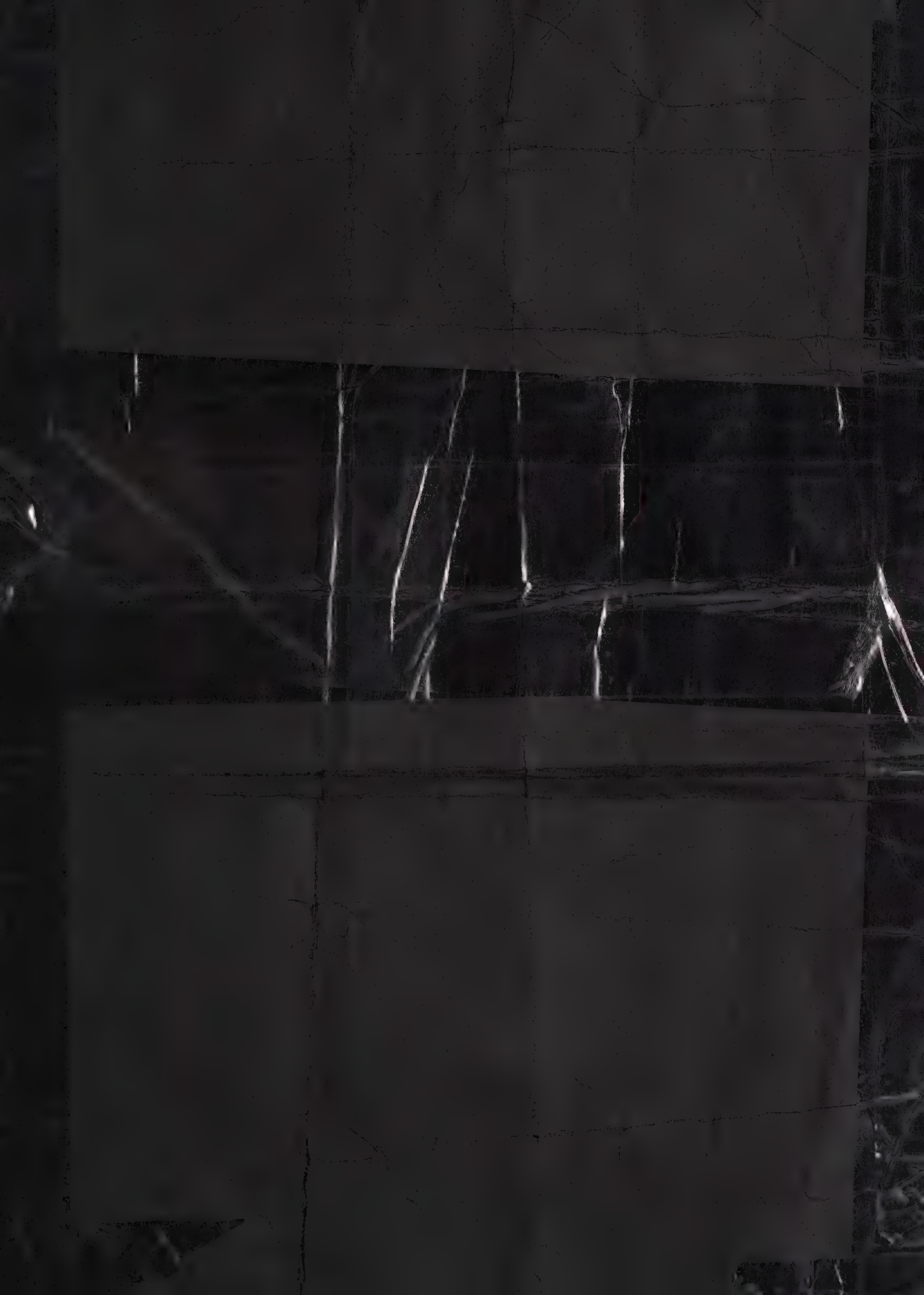
INSTRUMENT	SCHEMATIC
42B	830636
42BB	830658 SHT. 1
42BD	830592 SHT. 1
42B-18	830640
42B-19	830641
92B	830605
92BD	830581 SHT. 1
42B-22	830581 SHT. 1

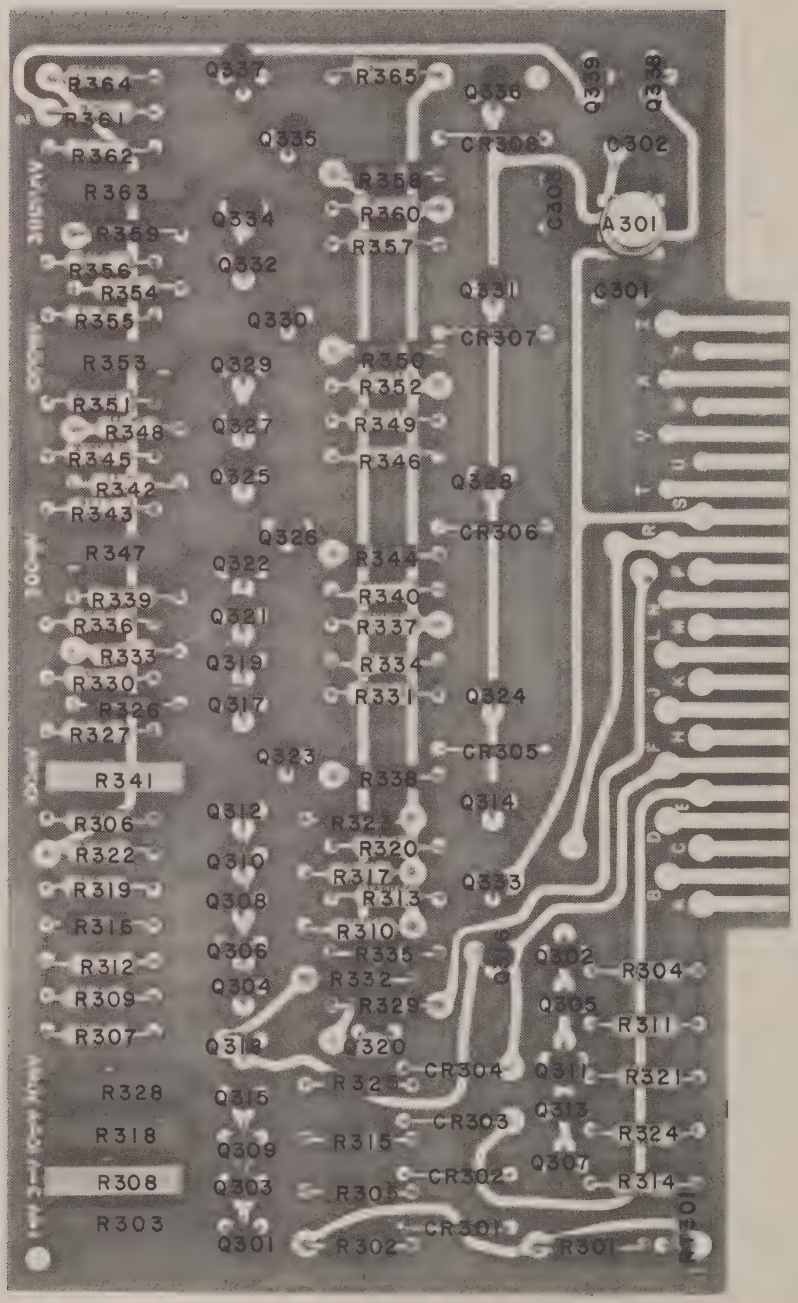
7. ON MODELS 92BD & 42BD THIS VALUE IS 0.47μF, 80V.

8. LAST NUMBERS USED:
R245 C217 Q214 CR219 A201

BOONTON ELECTRONICS CORPORATION

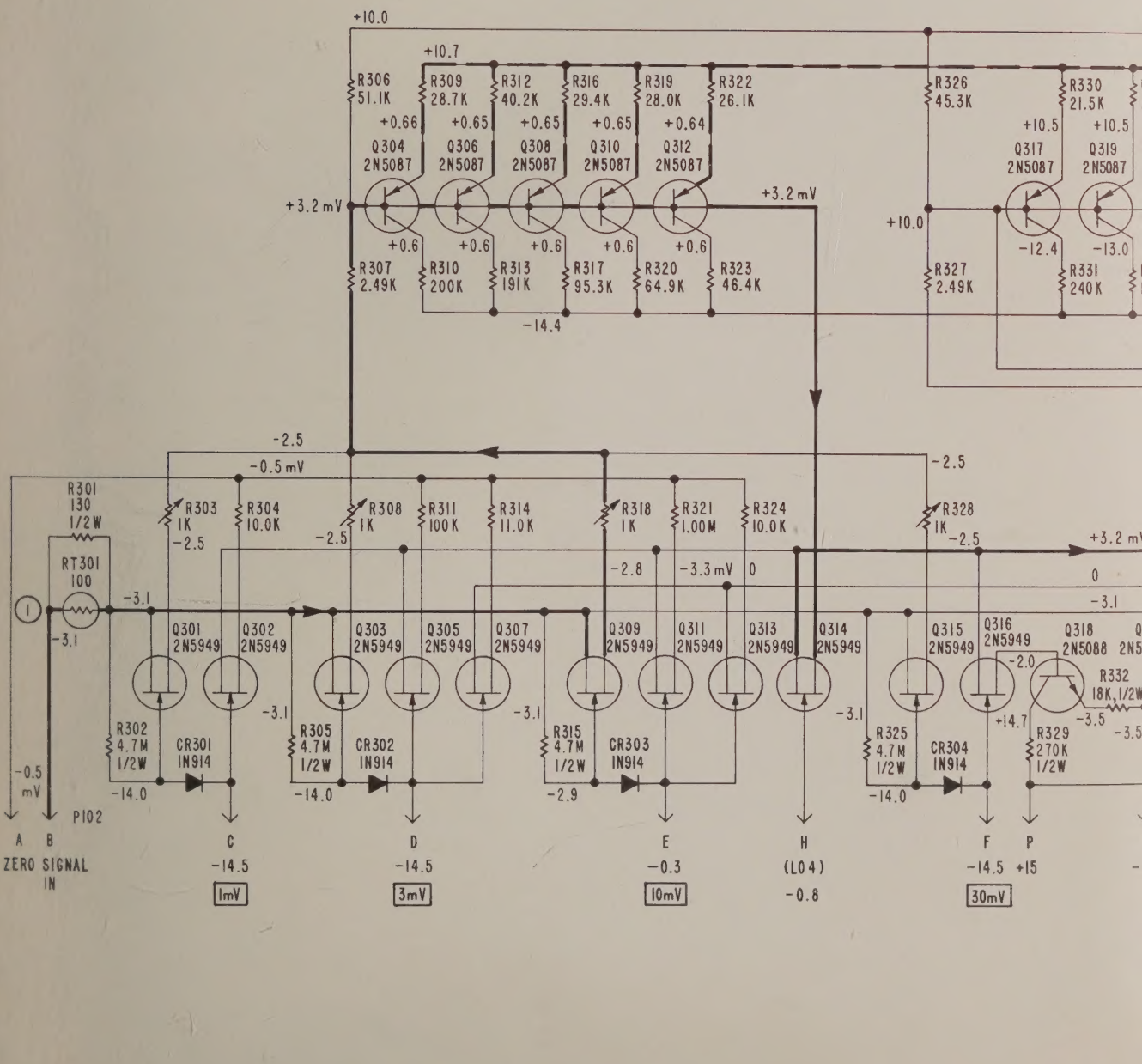
MODEL 92B/BD, 42B/BD
Schematic, Chopper Driver
D830581F (Sheet 3 of 3)

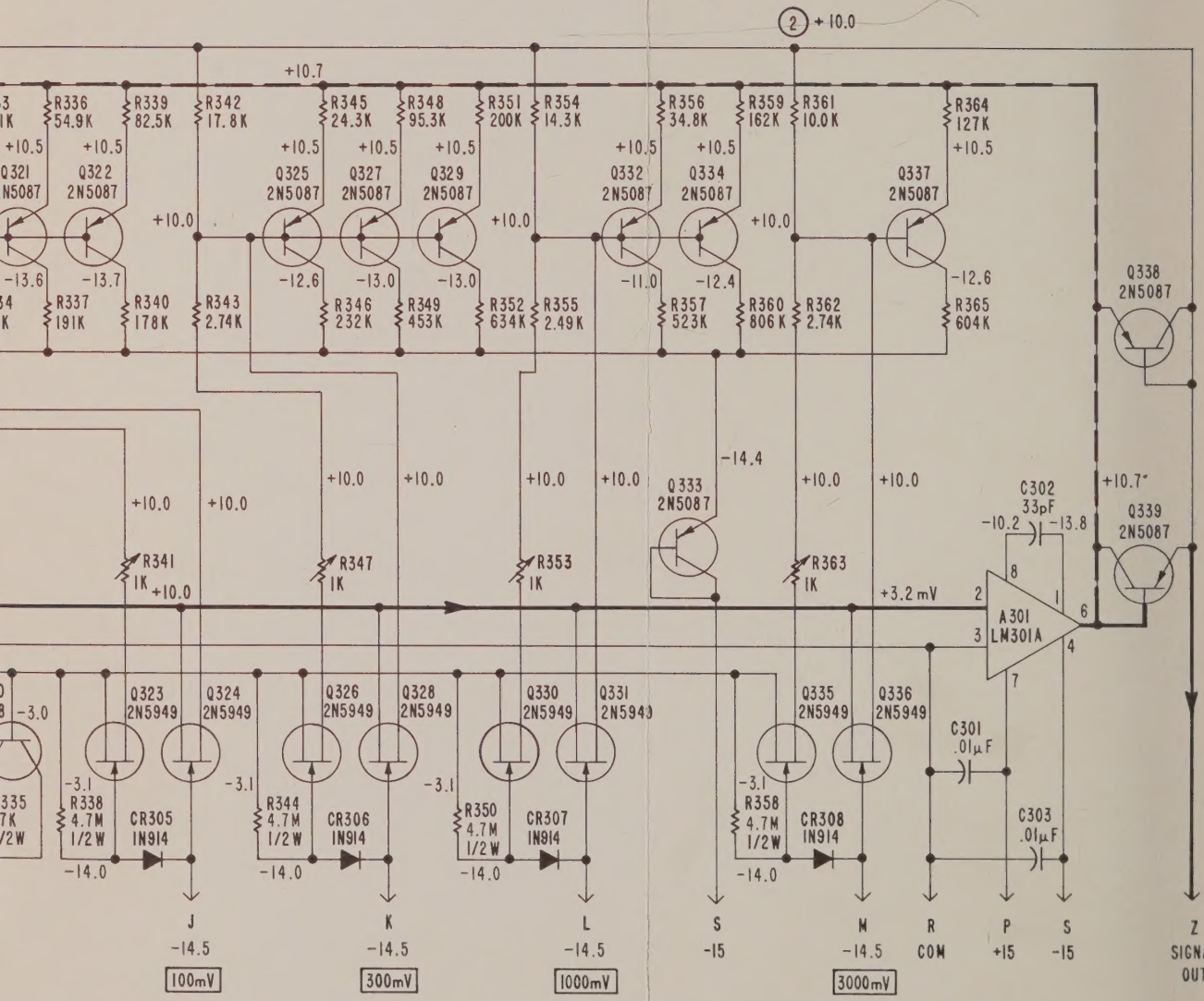



R364
R361
R362
R363
R359
R356
R354
R355
R353
R351
R348
R345
R342
R343
R347
R339
R336
R333
R330
R326
R327
R341
R306
R322
R319
R316
R312
R309
R307
R328
R318
R308
R303
Q337
R365
Q336
Q335
CR308
Q302
R358
R360
R357
Q334
Q332
Q331
Q330
CR307
R350
R352
Q329
R349
Q327
R346
Q325
Q328
CR306
Q326
R344
Q322
R340
Q321
R337
Q319
R334
Q317
R331
Q324
Q323
CR305
R338
Q314
Q312
R323
R320
Q310
R317
Q333
Q308
R313
R310
Q306
R335
Q302
R304
Q304
R332
R329
Q305
R311
Q320
CR304
Q311
R321
R326
Q315
Q313
CR303
R324
R315
Q309
Q307
CR302
R314
R305
Q303
CR301
R302
R301
Q301
A301
C301

NOTES:

1. RESISTANCE VALUES IN OHMS AND 3/8 WATT, UNLESS OTHERWISE SPECIFIED.
2. SIGNAL PATH ——————
3. FEEDBACK PATH — — — —
4. ▭ EXTERNAL MARKINGS
5. LAST NUMBER USED:
   R365 C303 Q339 CR308





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MODEL 92 SERIES
Schematic, Shaping Amp.
D830456G (Sheet 3 of 3

WARRANTY

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to active devices that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty. Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defines in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

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